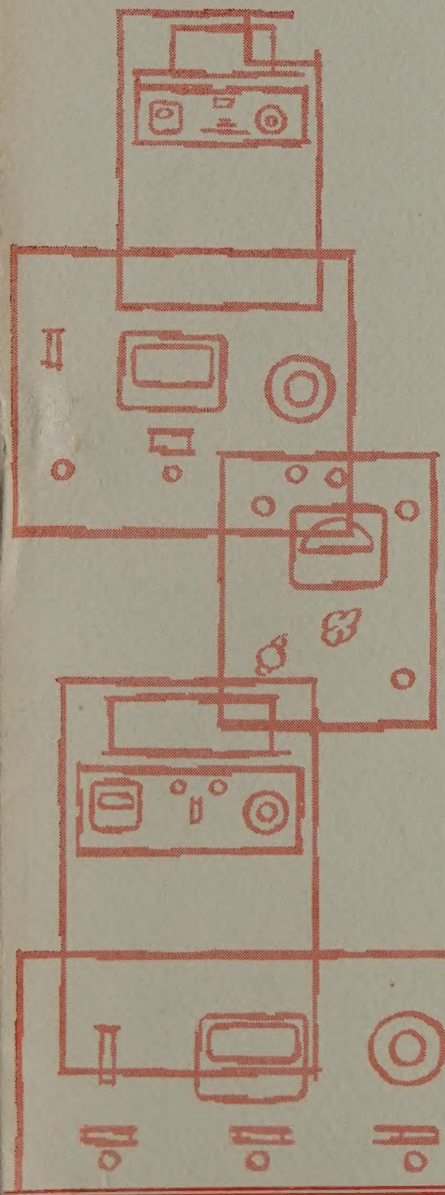
SAVE 6/25/77 Stan



ASSOCIATED RESEARCH, Incorporated

3758 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

MP MASTER
MA30111

INSTRUMENTS for measuring:

- Insulation Resistance . . the VIBROTEST®
- Ground Resistance . . the VIBROGROUND®
- Earth Resistivity . . the VIBROGROUND®
- High Voltage Breakdown, AC-DC . . the HYPOT®

OPERATING INSTRUCTIONS

MODEL 4300

30 KV AC - 1 KVA

CAUTION HIGH VOLTAGE

THE OPERATOR IS RESPONSIBLE FOR THE SAFETY OF ALL PERSONNEL WHILE USING THIS INSTRUMENT. DO NOT ATTEMPT TO CONNECT OR DISCONNECT ANY ITEM UNDER TEST WHILE THE INSTRUMENT HIGH VOLTAGE IS ENERGIZED. KEEP ALL PERSONNEL A SAFE DISTANCE FROM THE HIGH VOLTAGE OUTPUT WHILE MAKING HIGH VOLTAGE TESTS.

MODEL 4300 HYPOT

* * * * *

TABLE OF CONTENTS

Specifications ..... Section I

General Features ..... Section II

Operating Instructions ..... Section III

Schematic Wiring Diagram ..... Section IV

Replacement Parts List..... Section V

* * * * *

ASSOCIATED RESEARCH, INCORPORATED

3758 West Belmont Avenue

Chicago 18, Illinois

CIS-447
5 May 1960

SECTION I

S P E C I F I C A T I O N S

SPECIFICATIONS

MODEL:	4300 AC Bench HYPOT
INPUT:	115 volts AC, 50/60 cycle through five foot three conductor line cord with standard two-prong plug and ground clip located at rear of cabinet.
OUTPUT:	0-30,000 volts AC
CAPACITY:	1 KVA intermittent duty, .4 KVA continuous.
LEAKAGE INDICATOR RANGE:	1 MA to 10 MA (factory set at 5 MA).
CIRCUIT BREAKER SETTING:	33 milliamperes (approximately)
OUTPUT TERMINATION:	High voltage bushing with corona ball and ground terminal, located on top of cabinet.

SECTION II

GENERAL FEATURES

GENERAL FEATURES

"POWER" SWITCH

The "POWER" switch makes or breaks all input power to the instrument. In the OFF position, it opens both sides of the input line.

"OVERLOAD" BREAKER

An "OVERLOAD" breaker, sensing current demand in the GROUND or RETURN side of the output, turns off the high voltage when a secondary overload occurs due to arc-over or excessive leakage current in the item under test.

"VOLTAGE" CONTROL

A continuously variable "VOLTAGE" control gives the operator smooth control of the output voltage from zero to maximum. This "VOLTAGE" control is equipped with a zero return interlock switch, making it necessary for the control to be at its zero output volts position before the high voltage control circuit can be energized. This prevents the sudden application of high voltage to the item under test.

"H.V." SWITCH

This three position lever switch, operating in the low voltage input line, controls the energizing or de-energizing of the high voltage control circuit. With this switch in its center position, the high voltage control circuit is de-energized and no high voltage is available at the output termination, regardless of the position of the "VOLTAGE" control. In the UP position with the "VOLTAGE" control at zero volts, the high voltage control circuit will be energized and the lever switch will remain in this position until returned to center OFF by the operator. In the DOWN position with the "VOLTAGE" control at zero volts, the high voltage control circuit will be energized only as long as the operator holds the lever switch in this position.

"KILOVOLT" METER

The "KILOVOLT" meter meters the high voltage output from the instrument. It is connected directly across the output termination, thus indicating true terminal voltage irrespective of internal regulation.

"POWER ON" AND "H.V. ON" INDICATORS

These indicator lights signal the availability of POWER input and HIGH VOLTAGE output respectively.

"PRIMARY" BREAKER

This circuit breaker is thermally actuated and protects the primary against overload. If the "POWER ON" indicator fails to glow when the "POWER" switch is turned ON and the input cable is plugged into an outlet, press in the white button of this breaker firmly before concluding a power failure.

"LEAKAGE" INDICATOR

The "LEAKAGE" indicator light indicates excess leakage current flowing through or over the surface of the insulation of the item under test.

This is a useful and frequently misunderstood device consisting of a neon lamp connected across a variable resistor in the ground return side of the instrument. When the current flowing in the test circuit exceeds a certain value, the voltage drop across the variable resistor fires the neon leakage indicator.

When the leakage light glows it indicates that the preset value of current has been exceeded, but this does not necessarily mean there is defective insulation. Since the dielectric circuit under test is usually slightly capacitive, a certain portion of the current in the test circuit is due to its capacitive reactance. This capacitance current contributes toward the total current firing the neon lamp. In circuits having considerable capacitance where the capacitance current may be of considerable magnitude as compared to the normal expected leakage current, it may be desirable to set the leakage lamp to fire at a higher current value.

Because of the wide variety of items that can be tested with the HYPOT, there are many applications where the factory setting would cause needless indication. Ideally, the leakage light should be set high enough so that there is indication only when an abnormally high leakage current flow takes place, thus indicating a real defect. When experience proves that the factory setting of the indicator is too high or too low, the setting may be adjusted as follows:

For tests of material or items with low capacitance, first determine the leakage resistance that will permit the maximum acceptable leakage current. To do this, divide the required test voltage (thousands of volts) by the maximum permissible leakage current (in milliamperes). The figure thus arrived at will be the leakage resistance in megohms. A commercially available resistor of approximately this value should be obtained and used as a test standard. In some cases where the capacitance of the load is high, the reactance is correspondingly low, and the reactive or capacitance current may be considerably higher than the leakage current. The leakage light (since it is sensitive to both these currents) may therefore glow with good samples of material under test. To correct this condition, it is necessary to measure the capacitance of the specimen by using a capacitance bridge or other standard test methods. A commercially available capacitor close to this value (with a sufficiently high voltage rating) should then be connected in parallel with the test resistance (as determined above).

Connect either the standard resistor or the resistor and capacitor combination (referred to above) across the output of the HYPOT and raise the voltage to the previously selected test value. Remove the snap plug on the front panel, insert a small screwdriver in the hole and adjust the slotted potentiometer shaft visible within the hole, until the light glows. (Turning the shaft clockwise will increase,, while turning it counter-clockwise will decrease the current required to light the leakage light.)

As an alternate method of rough adjustment, several units may be selected and put into two groups: group one consisting of units known to be good, and group two of units known to be borderline or defective. Then adjust the leakage light so that the light does not glow when connected to the good units, but does glow when connected to the poor units.

When measurements are to be made on various types of units each having considerably different capacitance, several standards should be made up to assure that the calibration of the HYPOT corresponds to the unit being tested.

"SAFETY INTERLOCK" RECEPTACLE

The "SAFETY INTERLOCK" receptacle provides for interlocking the high voltage control circuit from a remotely located switch. This receptacle is electrically located in series with the high voltage lever switch, and has a jumper wire across the terminals of the mating plug as the instrument is shipped from the factory. To use the "SAFETY INTERLOCK", remove the twist-lock plug from its receptacle and remove the jumper wire from its terminals. Connect the wires of the remotely located switch to the terminals of this plug and re-insert the plug into its twist-lock receptacle. While the remotely located switch is open, the high voltage control circuit will be disabled and no high voltage will be available at the output termination, regardless of the setting of any other controls on the instrument. This switch must be closed in conjunction with the other conditions described under "H.V." SWITCH.

SECTION III

OPERATING INSTRUCTIONS

OPERATING INSTRUCTIONS

1. Place the "POWER" switch in its OFF position.

2. Turn the "VOLTAGE" control to its ZERO volts position (full counter clockwise).

3. Place the "H.V." lever switch in its center OFF position.

4. Plug the INPUT cable into the proper outlet (as specified under SPECIFICATIONS), and connect its GROUND clip to a good earth ground.

5. Connect the item to be tested to the HIGH VOLTAGE output bushing and the "GROUND" terminal. If the item to be tested is grounded, be sure the grounded side is connected to the "GROUND" terminal.

   TO MAKE CONNECTIONS TO THE HIGH VOLTAGE BUSHING, LOOSEN THE CORONA BALL ON THE TOP OF THE BUSHING AND BIND THE CONNECTION BETWEEN THE TWO WASHERS. WHEN PERFORMING TESTS, BE SURE THE CORONA BALL IS ALWAYS IN PLACE. WHEN MAKING CONNECTIONS TO THE HIGH VOLTAGE BUSHING, A CONNECTOR WITH ROUND CORNERS AND SMOOTH SURFACES SHOULD BE USED TO REDUCE CORONA WHEN TESTING AT HIGH VOLTAGE. IT MAY SOMETIMES BE NECESSARY TO TAPE THIS CONNECTION IF CORONA BECOMES EXCESSIVE DUE TO SHARP POINTS OR IRREGULAR SURFACES OF THE CONNECTOR. USE A GOOD GRADE OF PLASTIC OR RUBBER TAPE.

6. Place the "OVERLOAD" breaker in the ON position.

7. Turn the "POWER" switch ON.

8. Activate the "H.V." lever switch to either the UP or DOWN position as described under GENERAL FEATURES.

9. Rotate the "VOLTAGE" control clockwise until the desired test voltage is indicated by the KILOVOLTMETER.

10. Should the item under test break down, the "OVERLOAD" breaker will open and the high voltage circuit will be de-energized.

11. To re-energize the high voltage, repeat steps 2, 6, 8 and 9.

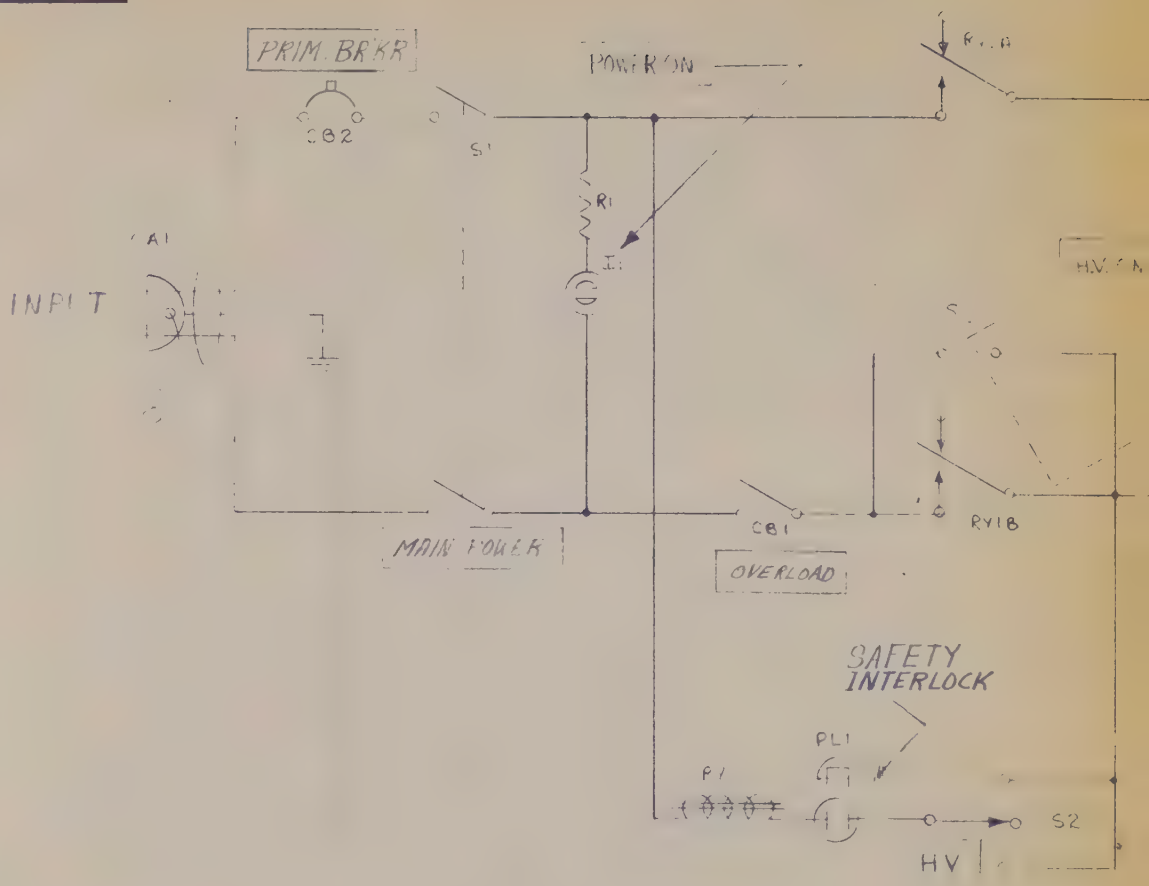
12. When the "LEAKAGE" indicator glows, the leakage current in the item under test has exceeded the indicator setting as described under FEATURES.

13. To re-energize high voltage should the "H.V." lever switch or "POWER" switch be turned OFF or the remotely located interlock switch be opened, it will be necessary to reclose that switch and repeat steps 2 and 9.

SECTION IV

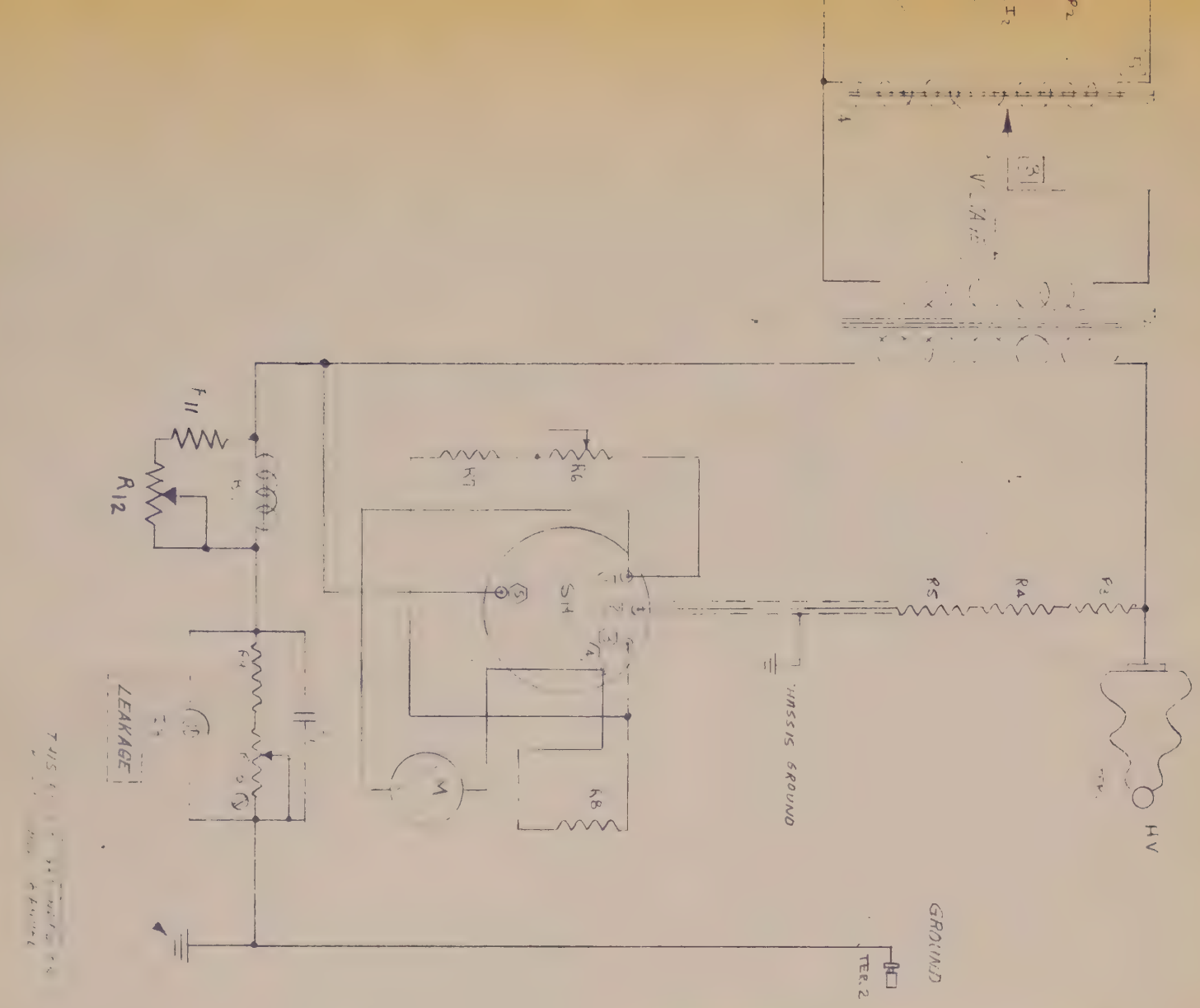
SCHEMATIC WIRING DIAGRAM

USED ON



SYMBOL LEGEND	
5	VARIABLE VOLTAGE CONTROL CONNECTIONS.
3	METER SHIELD CONNECTIONS.
	SEE DWG No A-3530-A FOR PARTS LEGEND.
	REFERENCES ENCLOSED IN RECTANGLES INDICATE FRONT PANEL CONTROLS.

DWG. # A 3530-



					TOL FRACT. ±
					DECIMAL ±
					SCALE
					MAT'L
B					
A	ORIGINAL ISSUE	4/20/56	F.L.	H.C.	FINISH
LET	CHANGE	DATE	BY	APP.	TOOLS

ASSOCIATED RESEARCH, Incorporated
"Precision Instruments Since 1936"
3758 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

MODEL [illegible] HV

DWN. F.L.	APP. H.C.	DWG. # A 35294
CKD. M.K.	SHT. 1 OF 1	

A E 198GL-8

SECTION V

REPLACEMENT PARTS LIST

DWG. # A 3530

USED ON

MODEL 4300 BENCH AC HYPOT
REPLACEMENT PARTS LIST

SYMBOL	PART NO.	DESCRIPTION
C_1	P8168	Capacitor, .002 mfd @ 2000 V.
CA_1	11649	Cable Assembly, input
CB_1	P8863	Circuit Breaker, magnetic
CB_2	P14167	Circuit Breaker, thermal; 15 A.
I_1	P14160	Lamp Assembly, Power On
I_2	P14159	Lamp Assembly, H. V. On
I_3	P11189	Lamp, Neon; Leakage Indicator
M	14668	Meter Assembly, Kilovoltmeter (less rect., shunts & shield ass'y)
PL_1	P11730 & P11729	Connector, male, safety interlock Connector, female, safety interlock
$R_{1, 2}$	P7031	Resistor, fixed; 100K, ± 10%, 1/2 W.
$R_{3, 4, 5}$	P11949	Resistor, fixed; meter multiplier
R_6	P1423	Resistor, variable; 5K, 2 W.
R_7	P10852	Resistor, fixed
R_8	P8143	Resistor, fixed
R_9	P14136	Resistor, fixed; 4300 ohms, ± 5%, 1 W.

R_{10}	P14669	Resistor, variable Leakaga Adj.
R_{11}	P8127	Resistor, fixed; 10K, ± 10%; 10 W.
R_{12}	P10988	Resistor, adj.; 10K @ 10 W.
RY_{1}	P14439	Relay, DPDT
S_{1}	P5005	Switch, DPST; power
S_{2}	P10637	Switch, lever; 2 pole, 3 pos.
S_{3}	P11785	Switch, snap; SPDT
SH	14591	Meter Shield & Diode Assembly
T_{1}	P11282	Transformer, variable auto, Volt Con.
T_{2}	P10462	Transformer, H. V.
TER_{1}	P10935	Bushing, H. V.
TER_{2}	P11817	Post, binding

ITEMS NOT SHOWN ON SCHEMATIC WIRING DIAGRAM

P11203	Lampholder, Leakage Indicator

	CHANGE	DATE	BY	APP.
C	CHANGED P10450 TO P14439	1-24-61	RW.	
B	/	11/18/60	Jam	
A	ORIGINAL ISSUE			
LET	CHANGE	DATE	BY	APP.

TOL FRACT ±
DECIMAL ±
SCALE
MAT'L
FINISH
TOOLS

ASSOCIATED RESEARCH, Incorporated
"Precision Instruments Since 1936"
3758 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

MODEL 4300
W.D. LEGEND & REPLACEMENT PARTS LIST

DWN. WM | APP.
CKD. | SHT. 1 OF 1

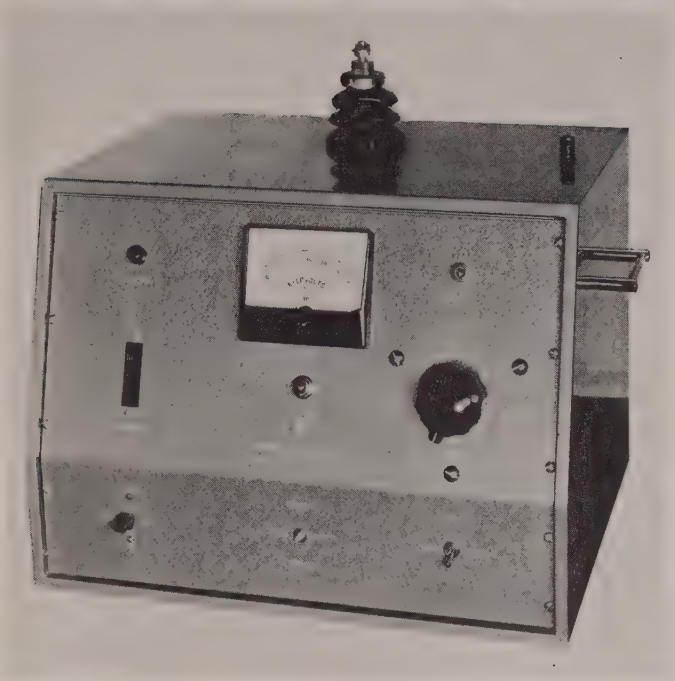
DWG. # A 3530

A E 198GL-8

No. 4-10.23

ASSOCIATED RESEARCH, Incorporated

ENGINEERING DATA SHEET



AC HYPOTS®

TO 35 KV

BENCH MODELS

4271	0-10 KV	1 KVA
4281	0-20 KV	1 KVA
4300	0-30 KV	1 KVA
4305	0-35 KV	1 KVA

BENCH MODELS ARE ALSO AVAILABLE WITH 2 KVA CAPACITIES.

APPLICATION

TESTING OF PLASTICS AND OTHER INSULATING MATERIALS, SHORT LENGTHS OF WIRE OR CABLE, COMPONENTS, ASSEMBLIES, ETC. WHERE THE DISTRIBUTED CAPACITANCE IS RELATIVELY LOW. FOR ANY HIGH VOLTAGE AC TEST THAT DOES NOT REQUIRE A HIGH CURRENT OUTPUT.

GENERAL FEATURES

INPUT: 115 VOLTS, SINGLE PHASE 50/60 CYCLE AC THROUGH FIVE FOOT, THREE CONDUCTOR LINE CORD WITH STANDARD TWO PRONG PLUG AND GROUND CLIP.

OUTPUT: CONTINUOUSLY ADJUSTABLE FROM ZERO TO MAXIMUM VOLTAGE. KVA RATING IS FOR INTERMITTENT DUTY. CONTINUOUS DUTY RATING IS 40% OF LISTED VALUE. OUTPUT TERMINATION IS THROUGH HV BUSHING (WITH CORONA BALL ON THE HIGHER VOLTAGE UNITS) AND GROUND TERMINAL.

CONTROLS: ON-OFF SWITCH WITH PILOT LIGHT; "HIGH VOLTAGE ON" LEVER SWITCH FOR MOMENTARY OR SUSTAINED APPLICATION OF HV; "HV ON" PILOT LIGHT; VARIABLE OUTPUT VOLTAGE CONTROL WITH ZERO RETURN INTERLOCK; CIRCUIT BREAKER RESET; LEAKAGE LIGHT.

METERING: 4-1/2" RECTIFIER TYPE KILOVOLTMETER CONNECTED ACROSS THE HV OUTPUT. ACCURACY ± 3% OF FULL SCALE. MODELS 4281, 4300 AND 4305 ALSO HAVE AN ADJUSTABLE LEAKAGE INDICATOR LIGHT.

- CONTINUED -

SAFETY FEATURES

Cabinet and panel at ground potential; high voltage circuits and external load protected by fast-acting magnetic circuit breaker set at maximum rated KVA (set at a lower point for some applications where fast break at lower voltages is required); primary circuits protected by thermal overload breaker; zero return interlock to prevent accidental application of high voltage; connector for remote safety interlock.

SPECIAL FEATURES

Voltmeter connected directly across HV output; readings are of actual test voltage applied irrespective of regulation or load; high quality heavy duty HV transformer has crest factor better than required by ASTM specifications for materials testing. Leakage light adjustable (by means of screwdriver) from front panel over range of approximately 1 MA to 10 MA.

CABINET DETAILS

Modern, sloping panel, gray hammertone bench cabinet with chrome lifting handles. Heavy aluminum panel of blue hammertone. Width: 20"; depth: 16-1/4"; height (less bushing): 14-3/4"; weight: 70 to 100 pounds.

OPTIONAL FEATURES

These bench AC HYPOTS may be furnished with any of the features listed below at the customer's request (at extra cost).

1. 220 volt, single phase 50/60 cycle AC input.
2. Multiple KV meter ranges.
3. Output current meter, single or multiple range (minimum range 10 MA full scale).
4. Dual range secondary overload circuit breaker. (For trip-out at less than full rating of HYPOT; especially useful on low voltage tests).
5. Adjustable secondary overload circuit breaker, for presetting maximum allowable secondary current.
6. Automatic rate of rise (see Bulletin 4-65.1).
7. 2 KVA output rating.

INSTRUMENTS for measuring
ASSOCIATED RESEARCH, INC.
3758 W. Belmont Ave Chicago 18, Illinois
• Insulation Resistance . . the VIBROTEST • Earth Resistivity . . the VIBROGROUND • Special Instrumentation for Laboratory,
• Ground Resistance . . the VIBROGROUND • High Voltage Breakdown, AC-DC . . the HYPOT Production, and Maintenance Needs

Reprinted from August, 1956

Electrical Manufacturing

Practical Hi-Pot Testing

The pet cliché of dielectric test-spec writers—"withstand without breakdown"—leaves a lot of room for interpreting test results. This vagueness, coupled with common misunderstandings of dielectric circuitry, can easily lead to false rejects. Here are some practical considerations for setting up both a-c and d-c high-voltage test stations.

JOHN T. KEEFE, *Application Engineer*
ASSOCIATED RESEARCH, INCORPORATED
Chicago 18, Ill.

JOHN T. KEEFE, *Application Engineer*
ASSOCIATED RESEARCH, INCORPORATED
Chicago 18, Ill.

Practical Hi-Pot Testing

The pet cliché of dielectric test-spec writers—"withstand without breakdown"—leaves a lot of room for interpreting test results. This vagueness, coupled with common misunderstandings of dielectric circuitry, can easily lead to false rejects. Here are some practical considerations for setting up both a-c and d-c high-voltage test stations.

CONSIDERING THE GREAT DIVERSITY of products that are electrically energized, it is not surprising that a wide variety of tests have been developed to meet specific needs of particular product groups. Current tests in use include high-potential testing (at power frequency), induced overvoltage tests, impulse voltage, insulation resistance, power factor, corona level, etc.

However, the two types in general use among all groups are the high-potential test and the insulation-resistance test. They are easy to apply and, in most cases, reasonably easy to evaluate. Also, test sets for this purpose are generally portable, reasonable in cost and suited to production line application, a factor of increasing importance.

The purpose of this article is to analyze the high-potential test as a means of evaluating the overall insulation quality of manufactured equipment. Actually, the high potential test has many other applications as well (*1*)* but this discussion will be limited to quality-control considerations only. The insulation-resistance test is different in nature and purpose and will not be treated here.

*Italic numerals in parenthesis refer to Cited References at end of article.

A-C High-Potential Testing

There are normally two major purposes for dielectric testing: First, to determine that the equipment insulation meets a level known to be satisfactory by the manufacturer himself. (How to set up and evaluate such criteria will be discussed later.) Second, to determine that the equipment insulation meets a level defined in specifications (or "standards") of some outside group, which the manufacturer is committed to meet or is following. The familiar MIL specifications and Underwriters' Laboratories Standards, as well as those of ASA, NEMA, JIC, and others, are common examples.

The mushrooming growth of electrical manufacturing, with the consequent emphasis on production, plus the fact that in many cases the electrical testing is done on a primarily mechanical product, has resulted in a general reliance on tests made in conformance with outside standards as the primary means of exercising quality control. For really analytical testing this approach can leave much to be desired and in addition may actually

permit substandard equipment to be passed. This seemingly paradoxical situation exists because:

1. Specifications and standards which define dielectric test requirements generally cover application to a wide range of items, hence must be couched in general terms.
2. The characteristics of high-voltage alternating current in dielectric circuits limit the development of specific yardsticks, as will be shown.

Yet the demand for greater reliability in the vast and growing array of new electrical and electronic mechanisms and components is leading many manufacturers to seek to extend the scope of "hi-pot" testing beyond its present status as a simple "pass-fail" test as outlined in existing standards.

The wording of a typical standards specification will help illustrate the lack of a definitive starting point: Underwriters' Laboratories states that a commercial cooking appliance " . . . shall be capable of withstanding without breakdown the application of a 60-cycle alternating potential . . . ," etc. (2) Almost all existing standards for electrically energized equipment are worded in similar fashion.

While the concept appears easy to apply, in practice each manufacturer will usually find that he must define for his own application what the phrase "withstand without breakdown" actually means. As the complexity of modern insulating structures and the variety of insulating materials increase, a hard and fast definition of what does or does not "withstand without breakdown" becomes a rather tenuous thing. No further help on this question of interpretation can be found in any official source, to the author's knowledge.

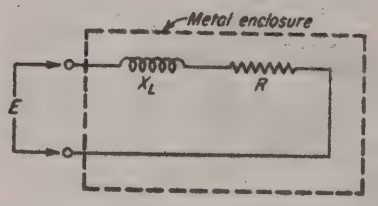
It is of course true that where an actual short circuit does exist in the insulation structure (zero insulation resistance at some point), the application of high voltage would produce a magnitude of current indicative of "breakdown." But how to detect the infinite variety of conditions which could exist between the completely defective insulating structure and a completely sound structure meeting the original design criteria?

The answer to this question lies in some fundamental considerations of alternating current circuit characteristics frequently overlooked.

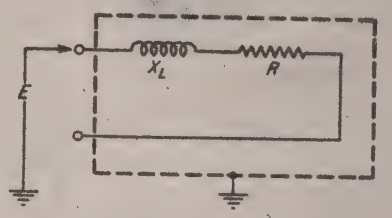
Dielectric Circuits. As illustrated in Fig. 1, the *dielectric* circuit encountered in hi-pot testing is quite unlike the *electrical* circuit of the device being tested. While the latter is most commonly a series inductive-resistance circuit, the dielectric test circuit is a parallel resistance-capacitance circuit. The resistance of the dieletric circuit is that of the insulation. The presence of shunting capacitance is to be expected, since the basic definition of a capacitor is two conducting surfaces separated by a dielectric. And the majority of high-potential tests are made between circuit conductors and other metal parts of the equipment that are insulated from each other. If the dielectric employed were a perfect insulator (infinite insulation resistance), the entire dielectric circuit could be represented as a perfect capacitor (ignoring absorption effects, which will be considered later).

Thus, the total current I_T which would flow in the test circuit of Fig. 1 consists of two components: the capacitive charging current I_C which leads applied voltage by 90 deg, and the true leakage current I_R which flows through the insulation and is in phase with the applied

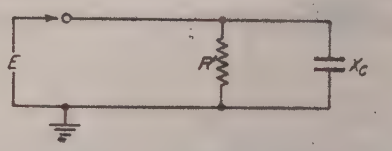
Fig. 1—Fundamentals of Hi-Pot Testing



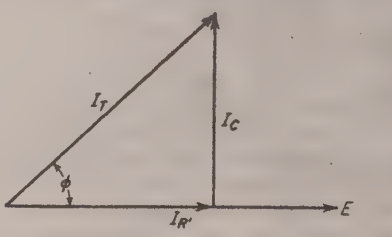
While most electrical equipment operates as an inductive load . . .



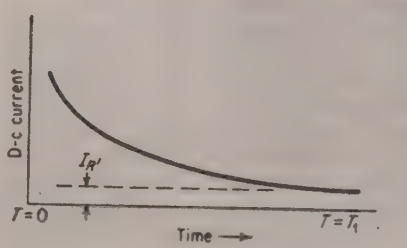
. . . the load presented to a high-potential dielectric tester . . .



. . . tends to be capacitive. For a-c tests the total test current is complex . . .

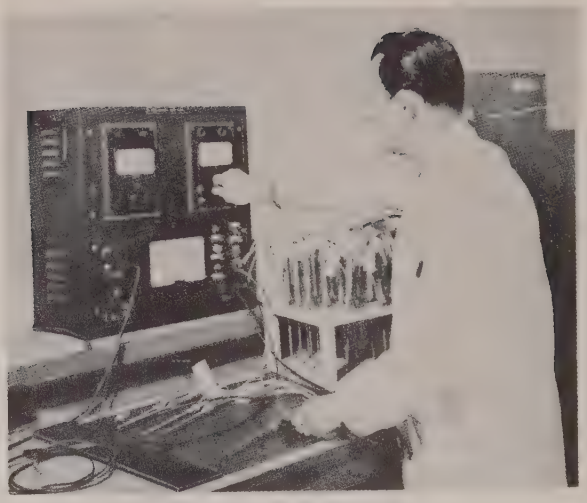


. . . and, for devices with highly capacitive geometry, may be much higher than true leakage current.



With d-c applied, test current decays to true leakage current, but testing time may increase considerably.

Typical Test Stations for . . .



. . . THERMOSTATS

Preliminary test panel for testing dielectric strength, insulation resistance and contact resistance of immersion-type thermostats. Unit incorporates standard high-potential a-c test set (upper right) and insulation-resistance test set (upper left)—both slightly modified with cases removed for panel mounting. Lower instrument is a multi-range ohmmeter. (*Fenwal Inc., Ashland, Mass.*)

voltage. For a given test voltage, the magnitude of I_R will depend on the insulation resistance, and of I_C on the circuit capacitance, which in turn is determined primarily by the geometric layout of the physical circuit. For example, a hi-pot test applied to a simple cord set (between conductors) would produce a current consisting almost entirely of I_R, since the conducting surfaces here would consist of only two short wires. The same test applied between widings and frame of a motor would produce a much larger current, primarily I_C, since we would have many turns of wire encased in a metal housing.

Critical laboratory analysis would show that there is actually a third component of current present known as the absorption current. (*3*) It can be visualized as a current which is actually "soaked up" by the dielectric, and is due to lack of homogeneity in the dielectric itself. The absorption current also has both a resistive component and a reactive (leading) one, thus tending to make the insulation resistance appear to be lower and circuit capacitance higher. Its magnitude depends on the nature of the dielectric and the frequency of the test voltage, but need not be compensated for in production testing.

An understanding of the complex current flow in a dielectric circuit under a-c high-voltage stress is important because, in the absence of visible or audible indication of breakdown, the current flowing in the circuit is the only major quantity left which is capable of interpretation. Thus the basic limitation of a-c testing can be summed up as follows:

1. The total current flowing is complex in nature and its magnitude does not necessarily depend on the condition of the insulation.
2. The total current flowing is *not* leakage current; leakage current is properly referred to as current flowing through the insulation, hence in phase with the applied voltage.
3. On highly capacitive equipment, a substantial change in insulation resistance would be required to produce a like change in the total current.

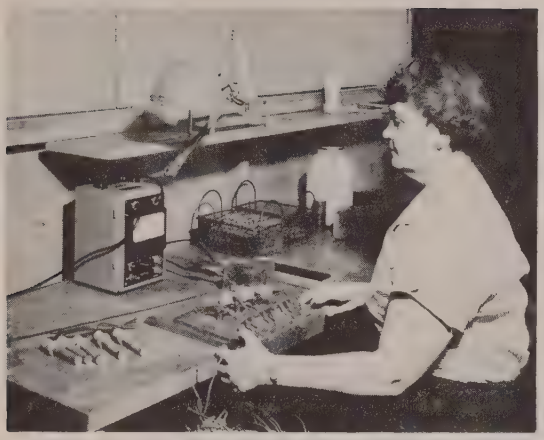
The circuit phenomena of a-c hi-pot tests have a direct effect on the requirements of equipment to perform these tests.

A-C Test Equipment. Any test set should meet the standard requirements of: transformer of sufficient capacity with a relatively pure sine wave output; continuously variable output voltage; voltmeter to accurately read output voltage at all times, etc. However, for practical quality control work there are several other very important requirements:

1. Obvious means should be provided to indicate defective equipment.
2. Defective units should be detected with a minimum of additional deterioration or destruction.
3. The test set should be suitable for production line applications.
4. The test set should be safe to use.

To date, two methods of indication have been built either singly or coincidentally into the smaller sets (under 5 kva)—an arc detector and/or a current-sensing device.

The first is a neon lamp connected across an r-f choke, usually connected in the ground side of the high voltage output and labeled "breakdown," "arcing," or "corona." This lamp operates on the principle that arcing ionizes the air sufficiently to induce a voltage across the choke to light the lamp (the ground lead acting as a carrier).



. . . FIRE DETECTORS

Simple fixture for gang testing of fire-detection units has two pushbuttons requiring the operator to use both hands to avoid accidental contact with hot leads while observing test meter. (*Fenwal Inc., Ashland, Mass.*)

. . . SOLENOIDS

Closeup view of simple dielectric test being applied to small solenoids for air conditioners. Tester includes variable autotransformer and voltmeter with breakdown, leakage and pilot lights. (*Spencer Thermostat Div., Metals and Controls Corp., Attleboro, Mass.*)

While no attempt has been made to precisely define the useful limits of this principle, under most conditions the lamp serves two useful purposes: (1) It will definitely indicate arcing, which in some cases might be otherwise undetectable to the operator; and (2) if the test voltage is applied slowly to an insulating structure including air, the initial ionization point of the air will be indicated by a faint glow, warning that impending breakdown is very near. The major drawback is a lack of indication for a failure not accompanied by arcing.

The second method of indication, using current-sensing devices, was first applied to small sets for testing toasters, coffee-makers, etc. The device consisted of a neon lamp connected across a variable resistor. When the total current flow through the resistor produced a sufficient voltage, the lamp indicated. On these small appliances the total current flow was almost entirely resistive and could therefore be considered true leakage current with negligible error. This lamp was commonly labeled a "leakage" light, and proved to be so useful that its application became increasingly popular. Because users tended to accept this general term literally, there were and are many instances of confusion caused by leakage indication on known good equipment which had sufficient distributed capacitance to draw a charging current exceeding the setting of the light. Under these conditions leakage indication may be entirely unrelated to actual leakage current flowing through the insulation. This difficulty is inherent in all current-sensing devices now in use, whether leakage lights, electronic "circuit breakers" or over-current relays.

However, such current-sensing devices can be used effectively in a production test setup by, first, estimating the average total dielectric current (at the test voltage) for acceptable samples and, second, specifying the setting of the current-sensing to be roughly twice this. This should be high enough to pass normal dielectric currents, yet low enough to detect defective insulation. Some adjustability of setting should be provided, particularly to raise the setting if the capacitive currents run higher than anticipated.

A simple tester such as this will be reasonably efficient where essentially duplicate items are tested. Where one unit is used to test such items as electrical motors in a wide variety of horsepower ratings, or varying lengths of wire or cable, a single current setting for all items may have to be so high to prevent false indication that its effectiveness will be materially reduced. Here a quick means for switching settings should be provided.

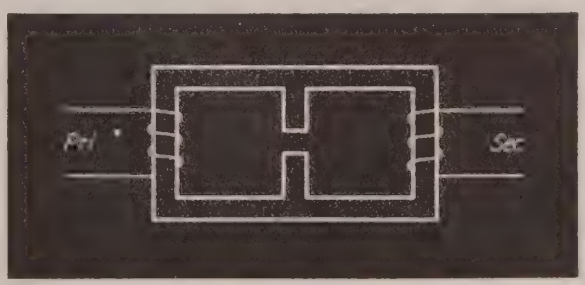
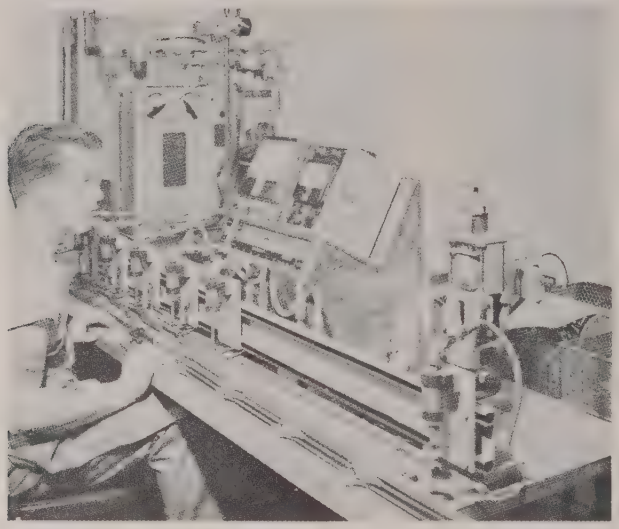


Fig. 2—Magnetic-shunt center leg of high-leakage transformer in the output circuit of an a-c hi-pot tester limits output current when tested insulation starts to break down.

Typical Test Stations for . . .



. . . WIRING HARNESSES

This particular test station does not include a hi-pot tester, but it serves to illustrate the degree of automaticity possible for such tests. Here, harness assemblies for gas-turbine thermocouples are pneumatically clamped and connected in the test circuit. Circuit-continuity tests and a 500-volt d-c insulation-resistance test are applied automatically. Necessary switching and indicating devices are built into the control unit, on which are mounted a multi-range ohmmeter and a standard insulation-resistance tester. (*Fenwal Inc., Ashland, Mass.*)

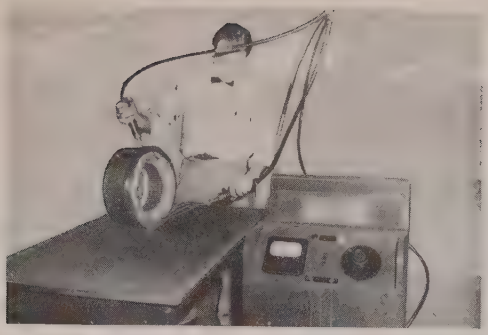
Limiting Destruction. Once a defective unit is detected, it is generally desirable that no further destruction take place. "Non-destructive" testing has become a phrase employed rather loosely in this connection. To state that the application of high voltage is non-destructive is a half truth. At best such testing will not do the insulation any good, and tends to be destructive in some degree. This is inherent in the application of high voltage to insulation, and has no relation to the type of test set. Destruction following failure can be limited, however, by providing the test set with any one of the following features:

High leakage transformers (Fig. 2). These employ a magnetic shunt across the secondary winding through an air gap. Under light loading of the secondary the shunt has little effect due to the low permeability of the air. However, at some value of volt-ampere output the magnetomotive force bridges the air to set up a magnetic short-circuit across the secondary, instantaneously limiting the maximum value of current which can be drawn from the secondary and reducing the output voltage to near zero. The transformer can withstand such conditions repeatedly without damage. Besides holding equipment damage to a minimum, the high leakage transformer also protects the operator. At present this type of construction has been limited to test sets under 500 va.

Current-limiting resistors. This is an older but still effective technique which will limit the maximum current flow of a test set of any construction. A minor drawback in their use is the necessity to use a transformer of a somewhat higher output voltage to compensate for the *IR* drop across the resistors and still permit adequate test voltage output. This may also affect the calibration of the voltmeter (depending on where the resistors are added in the circuit).

Mechanical protective devices. The sensitivity and speed of response of this type of protective device have been considerably improved, especially by use in conjunction with vacuum-tube amplifier circuits. On the larger sets this is generally the only protective device furnished. Being current-sensing in nature, however, they must be set high enough not to trip in the face of high capacitive currents, charging transients, etc. But a high setting may also introduce considerable time delay before tripping an actual fault current. If such devices were provided with an adjustable trip with reasonably wide range, and equally sensitive at all points, their major disadvantage would be eliminated.

Designing for Production. High-potential testing on a production line has several unique problems. The test must be performed quickly and accurately, often by unskilled personnel, without sacrificing any element of safety. Choosing the equipment is usually the smallest problem. A wide variety of small, reasonably priced a-c sets are available which are rugged, portable and provide means of detection which are suitable or can be made so for most applications. Other points to consider have already been mentioned, but on production testing particularly it is well to consider the possible savings through use of a test set also containing an audible alarm circuit. By freeing the operator from the need to watch the instrument panel, the testing rate can often be increased. In some instances the operator can be completely eliminated where the equipment is power conveyed past suitable terminals through which the test voltage can be applied automatically.



• • • MOTORS

For testing induction-motor stator. hot lead is applied to windings and ground lead to stator frame. Test instrument is a mobile 0-3000 volt, 3-kva unit. In operation the voltage is preset at the instrument panel but is actually applied by a pushbutton on the prod of the hot lead. The pushbutton makes contact in a 12-volt control circuit to energize a circuit-closing relay in the tester proper. For convenience the test leads are suspended from the ceiling by a pulley and counterweight arrangement to hold them off the floor at all times and yet permit their being moved to other test sites in the area. (*Ilg Electric Ventilating Co., Chicago, Ill.*)

This semi-production test of fhp capacitor motors also utilizes a 3-kva mobile tester but with an automatic 1-sec timer to control the application of a preset value of voltage. To speed up test, leads from five different motors are tied in parallel and connected to the hot lead. Likewise the frames are all connected to the ground lead. Breakdown in this type of application can be detected by observation of the test specimens as well as fluctuation of the voltmeter pointer. For complete failure, a circuit breaker will trip to interrupt the test. (*Ilg Electric Ventilating Co., Chicago, Ill.*)

Where the production rate does not make testing time critical, standard models of available test sets can usually be used economically without modification. Where extreme safety is required, the test specimen can be housed in a non-conducting test cage equipped with suitable interlocks. When several types of electrical tests are to be made, it is sometimes advantageous to group all tests at one spot with the units wired through a master control panel to suitable test jigs. Proper instruction of the operator is of course mandatory.

A considerably more difficult situation exists where production rates are such that testing must be done as rapidly as possible. Here it is well to consider if the situation might not justify using units engineered all or in part for the specific application, if no standard unit appears completely suitable. In such a selection it will be economically advantageous to obtain the standard unit most generally applicable and modify it oneself, or on special order from the supplier.

Speed and safety are a difficult compromise. The diversity of applications makes specific suggestions difficult, but the following may be useful:

1. Be sure test set is adequately grounded.
2. If the test voltage is applied "hot," design method of application so that handling of leads is unnecessary.
3. If equipment under test has an input with plug, terminate HV lead of test set in suitable terminal box. Contact metal parts with ground lead and then apply voltage by inserting plug into box. This is reasonably safe to operator and yet rapid in use.
4. If operator must handle both leads, equip the leads with retractable tip prods, and if the voltage must be applied hot, either furnish foot switch control, or include a control circuit with one of the output leads so that the application of test voltage can be manually controlled by the operator while handling the leads.

For additional safety, use of a "push-to-test" switch is recommended wherever practical. This must be held down by the operator in order to apply the output voltage and will keep at least one hand out of trouble. For complete safety two such switches used in series would do very well. On test sets of increased capacity, a "zero-return" interlock is worth consideration. This is a device which will prevent the reapplication of the test voltage once the "push-to-test" button has been released or the circuit breaker tripped until the voltage regulating device is returned to the "zero" position. It thus renders important safety service by preventing unintentional energizing of the high voltage output.

Testing Time vs. Voltage. Most standards require that rated test voltage be applied to the specimen for 1 min. However, where speed of testing is essential, some standards permit an optional test at a rated test voltage 20 per cent higher applied for only 1 sec. Most insulation currently in use has a definite endurance characteristic under applied high voltage a-c. Considering this, and the fact that no test sets currently on the market contain any sort of timing device, one is led to question how many tests are actually applied for 1 min., and also whether 120 per cent test voltage applied for 1 sec is really equal to rated test applied for 1 min. If a hi-pot test is not applied realistically in a manner capable of exposing a substandard insulation structure, then there is no point in applying such a test at all.

Typical Test Stations for . . .

. . . SYNCHROS

At this special test station the high-potential test is performed in conjunction with insulation-resistance, circuit-continuity and other tests. The simple a-c tester on the top shelf terminates inside the master control unit, as does an insulation-resistance tester (not shown). The setup here illustrates the complementary use of both high-potential and insulation-resistance tests, as follows:

First the operator mounts five synchros in the test fixture shown at left, sets circuit-selector switch on the control unit to "stator-rotor," sets test selector to "megohm," "zeros" the insulation-resistance tester—then reads and records the insulation resistance. Next the operator switches test selector to the hi-pot position, adjusts the voltage to 900 volts and presses the "start" button to apply potential to dielectric circuit and initiate an automatic 1-min timer. During timed test period operator watches breakdown indicator lamp on the tester.

At end of cycle the time indicator light on the

D-C High-Potential Testing

Increasing attention is being devoted to d-c testing by engineers, as evidenced by many AIEE papers on this subject. There are several basic reasons for renewed interest. The lack of real definition with a-c because of the masking effect of capacitive charging current has been pointed out. The main advantage of d-c, therefore, on quality control applications is the ability of the moving pointer on the ammeter to accurately spell out the true electrical behavior of the insulation.

To investigate the possible pros and cons of d-c testing, it will help to separate the items considered for testing into two groups, based on whether the time constants of the dielectric circuit are short or long. Figure 1 illustrates the theoretical current flow in an insulating structure when high voltage d-c is impressed on it. Initially the same three components of current are present as on a-c, i.e., capacitive charging current, dielectric absorption current, and true leakage resistance current. The subsequent action is quite different, however, as the first two components drop to zero after some finite time interval, leaving only true leakage current. This is true whether the voltage is applied hot or raised from zero, although the time interval will of course vary.

Short Time Constants. Assuming 1 min as the standard time of test, then our first group for consideration would be those items which under test would yield a true leakage current reading in less than a minute. For these items, d-c would appear to have great promise because insulation condition would be expressed quantitatively at a rated test voltage, not in such vague terms as "withstand without breakdown etc." It is true that some investigation may have to be made to establish suitable values of test voltage and duration of test so as to correlate with previous a-c experience. This should not be difficult and such data are now being accumulated by several manufacturers.

While d-c thus offers the positive advantage of definition, it must not be concluded that it is a panacea to solve all insulation testing problems. Balanced against its increased effectiveness will be probable higher cost of the d-c test set, as opposed to the small capacity a-c test set and its greater bulkiness due to the presence of additional rectifying and metering components. As the size of the equipment to be tested increases, the a-c test set rapidly becomes larger and more expensive than an equally effective d-c set, but it is hard to define where the shift in economics occurs. Considering commercially available test sets, it is the author's opinion that where an a-c test set of less than 500 va will suffice, it will be cheaper and smaller than a comparable d-c test set. An a-c set rated 500 to 1000 va will probably be cheaper but heavier. Above 1 kva, the a-c set will be both heavier and more expensive.

Another difficulty which may be encountered in varying degree, especially in rapid production testing, is the residual charge left on the equipment after a d-c test. For positive safety some method of discharging the equipment after test must be provided, either in the test set or in a separate jig or fixture. This can be an annoying problem as in some applications it will be necessary to short-circuit the tested item for a considerable time interval before safe handling can be assured. This would tend to slow down the rate of testing in order to provide protection to production personnel. Many small assemblies can actually be discharged almost instantaneously and so would present no problems, but it must be emphasized

control unit goes out; the operator reduces voltage to zero, switches back to the megohm test and again records the insulation resistance. For acceptance of the synchros, final insulation resistance must be above a certain value, with no indication observed on the breakdown light. Before-and-after insulation test is performed to catch any possibility of damage from the high-potential test.

The same tests are also performed for the stator-to-frame and rotor-to-frame dielectric circuits.

In a second series of tests each synchro is positioned on a mechanical jig, as shown, and the resistance of each winding is recorded as a circuit-continuity check. Finally with one winding energized the synchro is given a 1-min test, during which time the operator turns the rotor manually through two revolutions and watches for any fluctuation of primary current or tendency of the rotor to seek a preferred position. (*Arma Div., American Bosch Arma Corp., Garden City, N.Y.*)

that a potentially dangerous situation may be introduced and must be reckoned with.

In other respects small d-c and a-c test sets under 500 va appear to be about equally safe. The high-leakage transformer of Fig. 2 can also be used on the line side of a small d-c set for current limiting; its effectiveness here is generally increased by the higher internal impedance normal to a d-c set.

Long Time Constants. In considering the use of d-c on equipment where actual leakage current values cannot be obtained during the normal time of test, the situation becomes more complex. Dividing the applied voltage by the current value at the end of such a test period would yield an apparent resistance which could be much lower than the true resistance. This problem is also partially a function of the test voltage as at d-c voltages above 40 kv the corona current can be of considerable magnitude.

When the absolute value of the measured current cannot be used at the conclusion of the normal test period, several techniques can be followed:

1. Extend the test period until true leakage current can be read. This may require a time of application from 10 min to an hour, and its feasibility will depend strictly on the application. It would rarely be practical for a production setup except on extremely large equipment where time is secondary. But here the applied voltage can be raised gradually, and a highly capacitive piece of equipment can be tested by a d-c test set having a very small output—2.5 ma or less.

2. Retain the short test period and apply one or more empirical techniques of interpretation, such as: plotting and matching curves, determining polarization index, etc. However these techniques are beyond the scope of this article.

It might appear that the increased difficulty of interpreting current values would make d-c methods less advantageous on heavy equipment. Actually, quite the opposite is true. To date the greatest application for and progress in the use of d-c techniques has been with large rotating machines and wire and cable. For these applications, a-c test sets capable of applying a suitable high voltage to these items are much less mobile and substantially more expensive than an equally effective d-c set.

For this application d-c sets would appear to be safer than comparable a-c sets. Effective d-c testing can be done with output currents not exceeding 2.5-5 ma. The current output of equivalent a-c test sets, rated 5-25 kva, would be many times larger, and protective devices would be set proportionately higher. It is particularly important in this instance to re-emphasize that great care must be taken, after a high d-c voltage has been applied, to insure that all conducting surfaces and dielectrics which have been exposed to the high voltage field be solidly grounded afterwards and subsequently checked as necessary to eliminate any static charge from remaining or reappearing. Carelessness or ignorance here can have potentially lethal results, and testing should be done only with thoroughly trained personnel.

Summary

1. The high potential dielectric test continues to be one of the most important methods for determining the quality and probable endurance of an insulating structure.

2. The success of such a test will depend on the method of test setup, capability of the test set and skill of the operator. Current standards provide a basis for evaluation but in many cases are too vague to be of much assistance.

3. From a theoretical standpoint the use of direct current provides a more definitive quality control test than does alternating current. Supplementing existing standards by including d-c tests where advantageous is a subject which should receive further consideration and investigation.*

For many applications a-c will continue to remain a cheaper, faster and more flexible method of testing than d-c. Some increase in definition can be obtained by proper utilization of design features provided in currently available test sets.

For heavy equipment d-c testing loses some of its definitive ability but gains overwhelming advantages in economy and mobility. O O O

Cited References

1. "High-Potential Dielectric Strength Testing," John T. Keefe, Electrical Manufacturing, May 1955, p. 112.
2. "Standard For Commercial Electric Cooking Appliances," Underwriters Laboratories, Inc. Report No. 197.
3. "The Insulation of Electrical Equipment," Chapter III, Willis Jackson, John Wiley & Sons, New York (1954).

*As reported in "ASA Revises Standard for Rotating Electrical Machinery," Electrical Manufacturing, June 1956, p. 150, American Standard C50.1—1955 now permits d-c dielectric tests for synchronous-machine windings rated 6000 volts and above.

Read True Leakage Current

Smaller, Less Costly Than Equivalent in A.C.

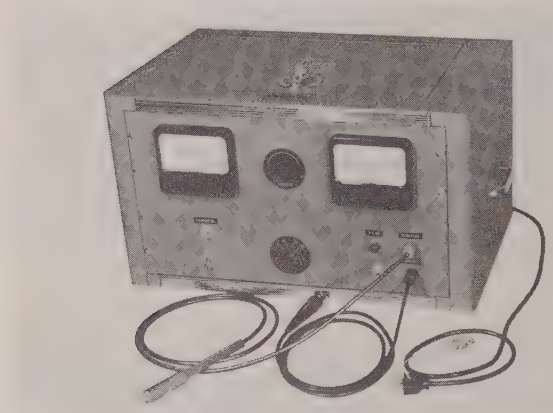
D.C. HYPOTS

FOR

NON DESTRUCTIVE HIGH VOLTAGE DIELECTRIC STRENGTH TESTING

Associated Research Inc., has grown to be one of the leaders in the field of D.C. High Potential Testing. This method of testing, though still in its infancy, is rapidly growing in prestige as the non-destructive dielectric strength test for insulating materials. The HYPOT test sets listed below are specifically designed for dielectric testing on the production line, in plant maintenance departments, material laboratories, and for use in the field in the testing of wire and cable installations and their related equipment.

PORTABLE BENCH TYPE



MODEL 424

Input: 50-60 cycle, 115 V.A.C.
Output: 0-5000 V.D.C.
Current Range: 0-5-10-50-100 microamps

MODEL 5002

Input: 50-60 cycle, 115 V.A.C.
Output: 0-5000 V.D.C.
Current Range: 0-5-10-50-100-250 microamps

MODEL 5001

Input: 50-60 cycle, 220-230 V.A.C.
Output: 0-5000 V.D.C.
Current Range: 0-5-10-50-100 microamps

MODEL 421

Input: 50-60 cycle, 115 V.A.C.
Output: 0-10,000 V.D.C.
Current Range: 0-500 microamps

MODEL 5011

Input: 50-60 cycle, 115 V.A.C.
Output: 0-10,000 V.D.C.
Current Range: 0-100-500 microamps

MODEL 5230

Input: 50-60 cycle, 115 V.A.C.
Output: 0-20,000 V.D.C.
Current Range: 0-50-250-2500 microamps

MODEL 5250

Input: 50-60 cycle, 115 V.A.C.
Output: 0-30,000 V.D.C.
Current Range: 0-50-250-2500 microamps

Models 424, 5002 and 5001 terminate in 1 pair of 5 ft. high-voltage test leads which plug into front of panel. Positive lead has red rectractable tip prod, ground has Alligator clip. Models 421, 5011, 5250 and 5230 terminate in standoff insulator and ground stud on top of case.

MOBILE TYPE

MODEL 5265

Input: 50-60 cycle, 115 V.A.C.
Output: 0-15-30-45 KV D.C.
Current Range: 0-50-250-2500 microamps

MODEL 5275

Input: 50-60 cycle, 115 V.A.C.
Output: 0-70,000 KV D.C.
Current Range: 0-50-250-2500 microamps

MODEL 5280

Input: 50-60 cycle, 115 V.A.C.
Output: 0-25-50-75 KV D.C.
Current Range: 0-50-250-2500 microamps

All Mobile Type D.C. HYPOTS are balanced for easy portability, and are equipped with a detachable push handle and cable reel. These units are ruggedly built to withstand field use and may be transported flat in the back of a car or station wagon. They are housed in a grey leathertone finish steel mobile type case mounted on 10" x 2.75" ball bearing semi-pneumatic puncture proof wheels. High voltage is obtained by use of the exclusive ARI AMPLIVOLT power unit; a rectifier-amplifier employing oil immersed long life selenium rectifiers.

HYPOT
Trade Mark Registered
JUNIORS

Speeds Dielectric Testing
Minimizes Errors

SIMPLICITY

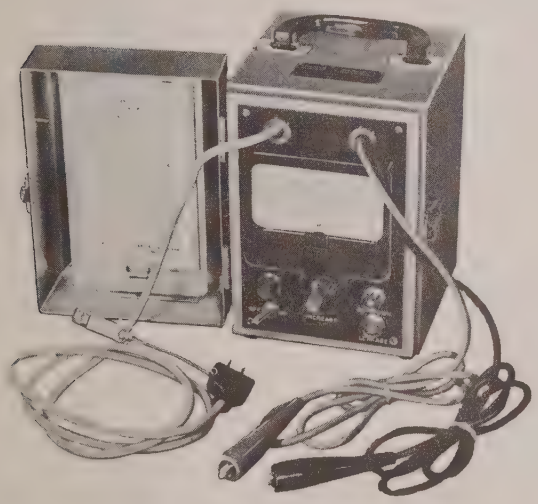
MAKE SURE YOUR PRODUCTS ARE ELECTRICALLY SAFE

Test For Shorts, Leakage, Breakdown

The Fabulous HYPOT Juniors Are Specifically Designed for Fast Accurate
High Voltage Dielectric Testing
CURRENT LIMITED FOR NON DESTRUCTIVE TESTING

LIGHT • COMPACT • PORTABLE • VIRTUALLY FOOL PROOF TO USE

VISUAL INDICATOR MODELS



400 SERIES

MODEL	OUTPUT	CAP V.A.
412	0-1500	50
411	0-2500	75
404	0-4000	100
405	0-5000	100
414	0-6000	140
422	0-10,000	230

GENERAL SPECIFICATIONS

Input: 50-60 cycle, 115 V.A.C.
Output: Continuously variable output voltage from zero to maximum.

Indicator Lights: 3 Neon; "ON-OFF," leakage, breakdown, Leakage light set to glow at 0.5 MA. Standard (500 volts per MEG). Settings other than 0.5 MA, between 0.35 MA and 2.5 MA available on special order. Above models can be modified for settings between 0.1 MA and 0.35 MA or 2.5 MA and 10 MA when desired.

Housing: Grey Hammertone baked enamel finish, with removable cover. Compartment in cover for storage of test leads, line cord and instruction manual.

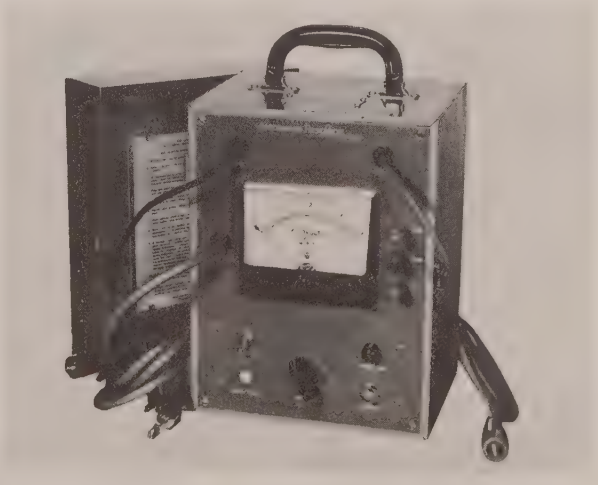
Dimensions: 6" x 9" x 8½"; Model 422, 8⅝" x 11½" x 10". All HYPOT Junior Models except Model 422 terminate in 1 pair of 5 ft. high-voltage test leads, with terminals and rubber shielded Alligator clips. Model 422 terminates in a standoff insulator and ground stud.

VISUAL AND SOUND INDICATOR MODELS

The Model 430 HYPOT series was specifically designed for production line testing applications, where it is undesirable or impractical for the operator to continuously watch the instrument for fault indication. A clearly audible alarm buzzer is heard in the event of excessive leakage current or failure of the insulation under test. The standard leakage circuit is set at 0.5 MA. Settings other than 0.5 MA, between 0.5 MA and 1 MA available on special order. Above models can be modified for settings between 0.3 MA and 0.5 MA or 1 MA and 10 MA when desired. These features make these HYPOTS extremely valuable tools for quality control testing of Motors, Components, Appliances, and other items requiring rapid and accurate high voltage insulation testing.

MODEL	OUTPUT	CAP V.A.
430	0-1500	50
431	0-2500	75
432	0-4000	100
433	0-6000	140

Dimensions: 8⅝" x 11½" x 10"



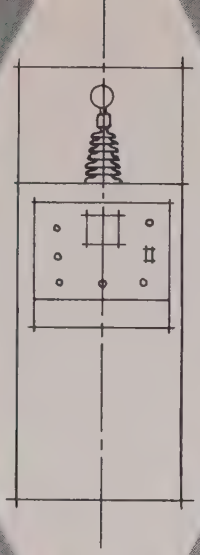
Other current limited A.C. HYPOTS are available for automation or control application.
There is an ARI HYPOT for every High Potential Testing Requirement.

MANUFACTURERS OF THE ONE AND ONLY HYPOT

Reprinted from ELECTRICAL MANUFACTURING, August 1956, page 108
Copyright 1956 by The Gage Publishing Company

ASSOCIATED RESEARCH, INC.

Bulletin 10-1.3



INSTRUMENTS for measuring:

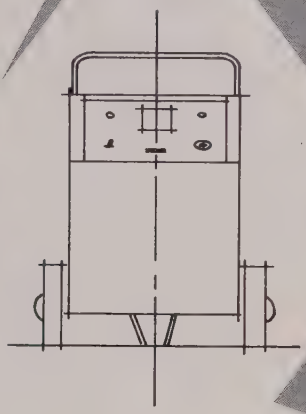
- High Voltage Breakdown
- Dielectric Strength
- Insulation Resistance
- Ground Resistance
- Earth Resistivity

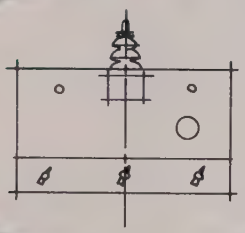
and

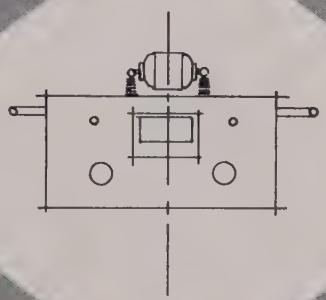
High Voltage Power Supplies

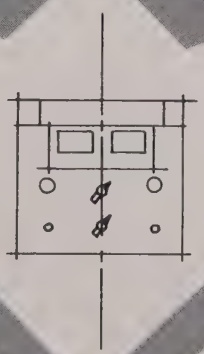
Automated Test Systems

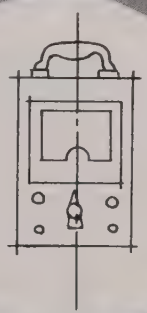
Special Instruments for Laboratory, Production and Maintenance











ASSOCIATED RESEARCH, Incorporated

3758 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

COrnelia 7-4040

Since 1936

ASSOCIATED RESEARCH, INC.

INSTRUMENTS

for

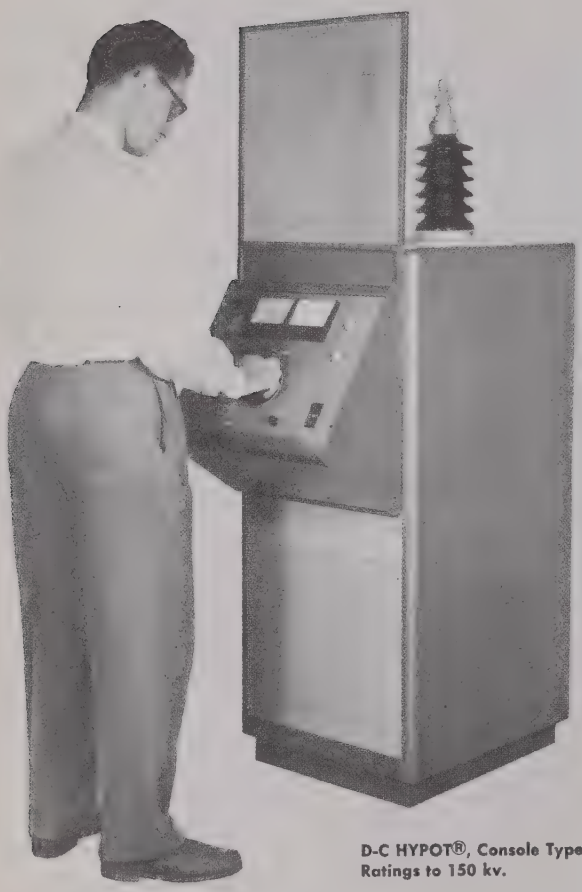
Research . . Quality Control . . Production . . Maintenance

Founded in 1936 by James F. Inman, Associated Research, Inc., has developed a wide range of instrumentation for measurement of resistance, insulation leakage current, dielectric strength and allied applications.

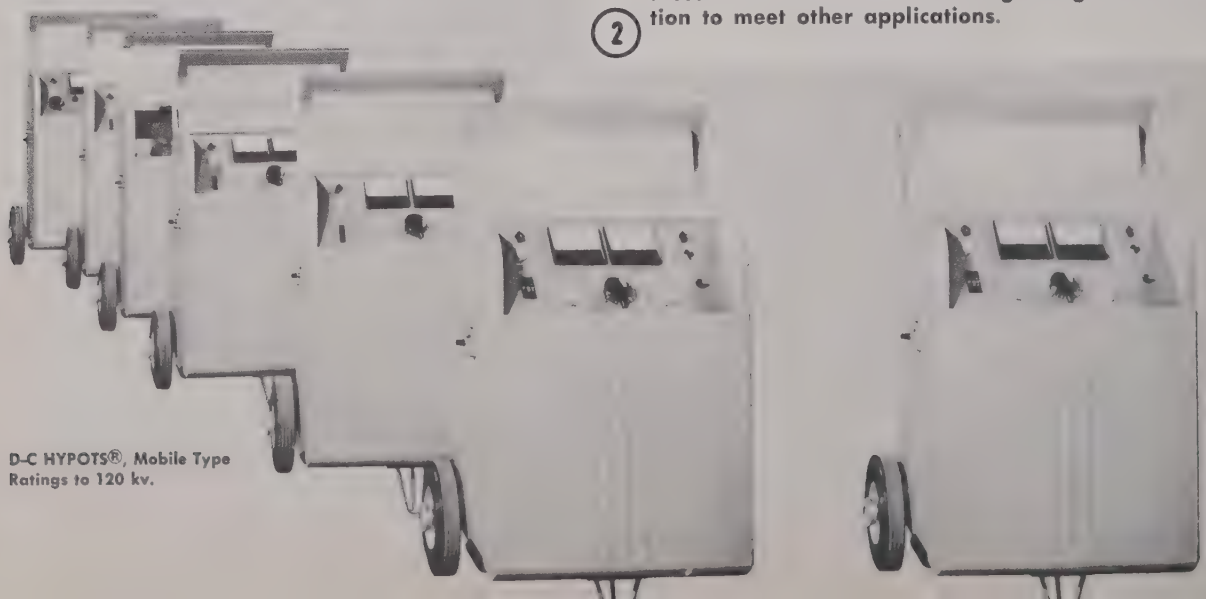
This CONDENSED CATALOG lists the following basic instruments and services:

Special Instrumentation	page 3
HYPOT® Dielectric Strength Test Sets	
Heavy Duty Models	page 4
Console & Mobile Models	page 5
Cable Fault Locator	page 5
Bench & Portable Models	page 6
Insulation Materials Tester	page 7
Insulating Oils Tester	page 7
Arc Resistance Tester	page 7
Corona Test Equipment	page 7
HYPOT® Power Supplies	page 7
VIBROTEST® Megohmmeters	
Research, Laboratory, Production	page 8
Maintenance of Electrical Equipment,	page 8
Floor Conductivity Measurement	page 8
VIBROGROUND® Ground Resistance Tester	
Resistance of Man-Made Grounds	page 9
Corrosion Control Engineering	page 9
Geophysical Subsoil Exploration	page 9
Pilotal Ohmmeter	page 10
Portable Precision Ohmmeter	page 10
Phase Sequence Indicator	page 10
Portable Kilovoltmeter	page 10
Sphere Gap Assemblies	page 10
Automated Testers	page 11
Current Transformers for Metering	page 11
Polygraph (Lie Detector)	page 11

You are invited to write for detailed specifications on these instruments as well as regarding instrumentation to meet other applications.



D-C HYPOT®, Console Type
Ratings to 150 kv.



D-C HYPOTS®, Mobile Type
Ratings to 120 kv.

Special Instrumentation

Custom designed automatic high voltage circuit and component analyzer. Supplied to wire manufacturer for dielectric strength, insulation resistance and continuity testing of 120-conductor cable.

Designed to Your Needs

In addition to the standard designs listed on the following pages, the engineering staff of Associated Research, Inc., offers:

CUSTOM TEST EQUIPMENT

Recommendations for and quotations on special instruments that include one or more of the following measurements and tests:

Continuity: Resistance measurements from a fraction of an ohm . . . to megohms.

Insulation Resistance: From one megohm to *FIVE Million* megohms.

A-C HYPOT® Testing: From 100 volts to 150,000 volts.

D-C HYPOT® Testing: From 100 volts to 250,000 volts.

Leakage Current Measurements: From a fraction of a microampere to many milliamperes.

MODIFICATION of STANDARD INSTRUMENTS

Many modifications of standard instruments in the line (in addition to the listings of optional extras) are available to meet specific application needs.

Upon receipt of your requirements, our engineering staff will promptly prepare recommendations for your consideration.

Private Label Instruments

Our engineering and production facilities are available for the design and manufacture of special test equipment, sold under private label by nationally known industrial organizations. Inquiries regarding your needs are invited.

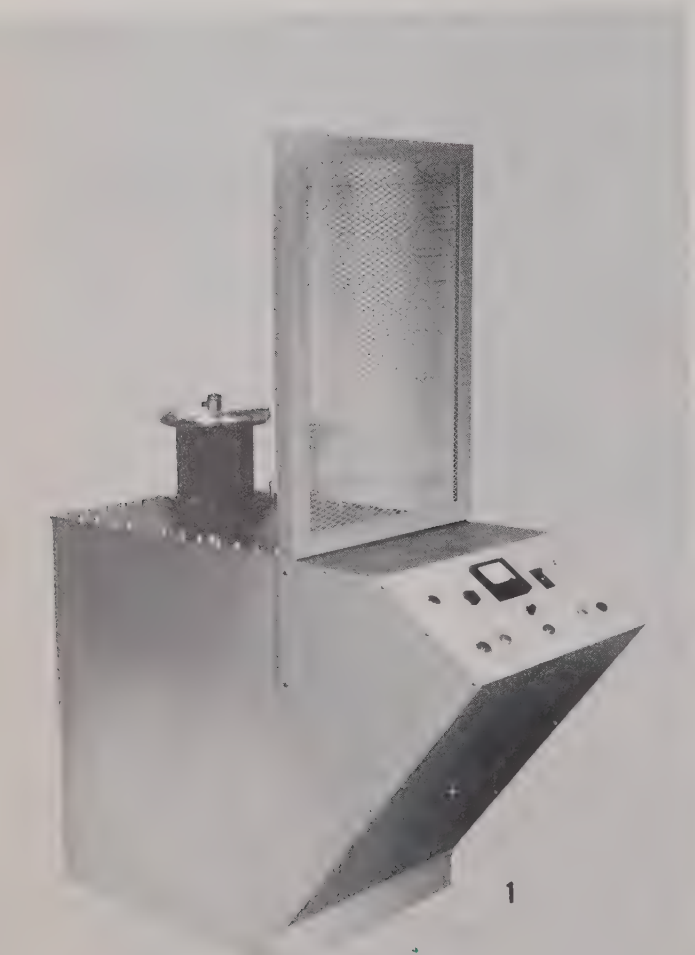
Production testing of control circuit components for high voltage breakdown and insulation resistance. On right, the HYPOT® Jr. and on left, the VIBROTEST® megohmmeter.

High Voltage Breakdown Testing . . A-C or D-C

A full range of instrumentation for non-destructive breakdown tests is offered. Pages 4, 5, 6 and 7 of this catalog describe each basic series. Page 11 gives data on automated systems for dielectric strength testing. Page 3 refers to instrumentation combining dielectric strength testing with tests that are frequently made concurrently.

Our experience as one of the largest and best equipped producers of heavy duty dielectric test sets has shown the need for wide variations in the facilities to be embodied in the individual test set.

Thus, basic HYPOT® designs presented on these pages are essentially for reference. Additional facilities required for specific applications may be incorporated. Many of the useful features described are available only in HYPOT® test sets. Provisions for material and equipment testing in accord with applicable ASTM, MIL, and Federal Specifications are provided by suitable HYPOT® models.



1

Very High Voltage D-C HYPOTS® . . 150 to 250 KV

These test sets are available with ratings of 150 kv to 250 kv, and maximum current outputs of 2, 5, 10 or 25 ma. Operating controls may be located on the main cabinet similar to Fig. 1, or in a separate bench cabinet. Output is through a heavy-duty, oil-filled, corona-free bushing.

Standard features include: 4½" Kv meter connected directly across high voltage output; 4½" electronically protected multiple range current meter; metered return and bypass guard circuits to measure load (leakage) current or bypass (guard) current; long-life selenium rectifiers; fast-acting magnetic circuit breaker for protection of high voltage circuits and external load; primary circuit protected by thermal overload breaker. Additional safety provisions include zero-return interlock, connector for remote interlock, cabinet and panel at ground potential, grounded screen between operator and high voltage bushing.

Optional features include: Automatic rate of voltage rise, adjustable high limit shut off controlled by voltage or current; corona pick-up and detector; kilovoltmeter memory circuit to retain reading of breakdown voltage; multiple output voltage measuring ranges; vacuum tube microammeter with ranges as low as 2 microamperes full scale. Additional features are described in special bulletin.

Heavy Duty A-C HYPOTS® . . 150 KV, 10 KVA

For testing large rotating machinery, heavy equipment, line materials, cables, insulating liquids and materials . . . available with ratings to 150 kv at 10 kva and higher. Input; 220 v, single phase. Output continuously variable from zero to maximum. Terminates in a corona-free, oil-filled bushing.

Standard features include: Rectifier type 4½" kilovoltmeter directly across the high voltage output. Housed in heavy steel, caster-mounted cabinet (Fig. 1). Cabinet and panel are at ground potential. Grounded safety screen is between the high voltage bushing and the operator. Additional safety features include: Zero return interlock; connector for remote interlock; fast acting magnetic breaker in output to protect high voltage circuits and load; primary circuits protected by thermal overload breaker.

Optional features include: Multiple kilovoltmeter ranges; single or multiple range output current meter; dual range or adjustable secondary overload circuit breaker; adjustable high limit shut off for voltage or current; kilovoltmeter memory circuit to maintain reading of breakdown voltage; automatic control for rate of rise with pre-set dwell; corona pick-up and detector; control section in separate bench type cabinet; and others detailed in special bulletin.

Automatic Rate of Rise Control . . . Most of the A-C and D-C HYPOT® models may be equipped with automatic control to raise or lower the output voltage at a predetermined rate as required by many test specifications. Single speed, multiple speed or continuously adjustable options are available. Timer to permit presetting dwell period may also be included. Full description will be obtained by requesting bulletin.

HYPOTS®

Console A-C HYPOTS® . . 75 KV, 5 KVA

Models have outputs continuously variable from 0 to 30 kv, on up to 75 kv, at ratings of 1, 2, or 5 kva. Housed in caster-mounted steel cabinets finished in baked grey hammertone, with aluminum control panels in blue hammertone. Dimensions: 21¼" wide, 25½" deep plus 10" for control panel, 51" high plus 20" to top of protection screen. Weights from 600 to 1100 pounds. (Fig. 2). Standard and optional features include those listed for the "Heavy Duty A-C HYPOTS®" on the preceding page.

Console D-C HYPOTS® . . to 150 KV, 10 MA

For non-destructive testing of insulating materials, cables, transformers, switchgear, motors and generators. Outputs continuously variable from 0 to 100 kv through 150 kv, with standard current ratings of 2.5, 5, and 10 ma at maximum voltage. Lower voltage and/or higher current units are available.

The caster-mounted console cabinets are similar to those of the "Console A-C HYPOTS®" described above. Weights from 650 to 850 pounds. Standard and optional features include those listed for the "Very High Voltage D-C HYPOTS®" on the preceding page.

Mobile A-C HYPOTS® . . to 30 KV, 10 KVA

Mobile A-C HYPOTS® for testing large rotating machinery, line materials, short lengths of cable, and insulating materials.

Available with outputs continuously variable from 0 to 5, 10 and 20 kv at ratings of 1, 2, 5 or 10 kva. 30-kv models can be supplied with ratings of 1, 2, and 5 kva. Input is 115 v for 1- and 2-kva models, and 220 v for 5- and 10-kva models.

Standard features include: Rectifier type 4½" kilovoltmeter directly across high voltage output; zero return interlock; connector for remote safety interlock; high voltage circuits and external load protected by fast-acting magnetic circuit breaker; primary circuit protected by thermal overload breaker; cabinet and panel at ground potential.

Housed in a welded steel cabinet with cable reel, detachable push-handle and semi-pneumatic wheels. Dimensions are: 23" wide, 21" deep, and 41" high. Weights range from 150 to 250 pounds. (Fig. 3).

Optional features include: Multiple kilovoltmeter ranges, milliammeter, secondary overload circuit breaker with adjustable limit or dual range, and burn test circuit.

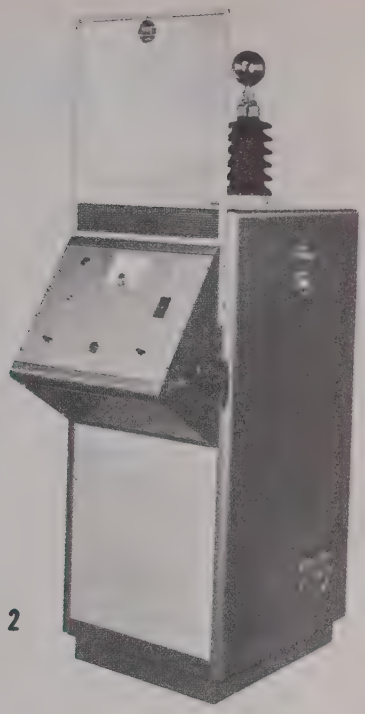
Mobile D-C HYPOTS® . . to 120 KV, 10 MA

Heavy-duty mobile test sets for determining insulation leakage and dielectric strength of cables, bushings, switchgear, transformers, motors and generators . . . on the factory floor, outdoors, or in mines and quarries.

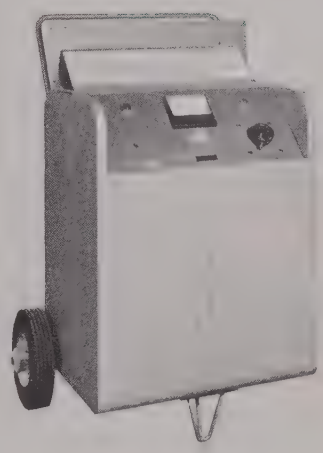
Outputs continuously variable from 0 to 45 kv and on up to 120 kv, with ratings of 2.5, 5, 10 ma, at full voltage. Operate from 115 v, a-c. High voltage receptacle may be oil filled for corona-free connection. The mobile cabinets are similar in design and dimensions to those listed for the "Mobile A-C HYPOTS®." Weights range from 285 to 450 pounds.

Standard features include: 4½" kilovoltmeter connected directly across the high voltage output; three-range 4½" microammeter electronically protected against overload; zero return interlock; connector for remote safety interlock; fast-acting magnetic circuit breaker in output to protect high voltage circuits and external load; thermal overload breaker to protect input circuits; long-life selenium high voltage rectifiers; metered return and bypass return terminals for measurement of load (leakage) or bypass (guard) currents.

Optional features include: Multiple output voltage ranges, vacuum tube microammeter with ranges as low as 2 microamperes, full scale, reversible polarity, adjustable high limit shut off for voltage and current.



2



3

"Thumper" Cable Fault Locator

"Thumper" Cable Fault Locator converts the high voltage, low current output of a d-c high potential test set into high-voltage (up to 25 kv) high-current impulses to allow ready location of faults in electrical power cables. The frequency and intensity of the high-current impulses are adjustable while the "Thumper" is in operation. A 25-kv model is available as an accessory unit for use with suitable high potential d-c testers. Smaller units may be incorporated as a built-in feature in many of the D-C HYPOTS®. Descriptive bulletin is available.

HYPOT® Dielectric Test Sets

Bench and Portable Models

Bench Type D-C HYPOTS® . . to 45 KV, 25 MA

Output voltages continuously adjustable, zero to maximum of 5 kv to 45 kv, and full load current ratings of 100 microamperes to 25 milliamperes or more. The steel bench-type cabinet is same as described for Bench Type A-C HYPOTS®. (Fig. 6).

Standard features include: 4½" kilovoltmeter directly across the high voltage output; three-range current meter electronically protected against damage from overload; fast-acting circuit breaker in output; thermal overload breaker in primary; long-life selenium rectifiers; grounded panel and cabinet; zero return interlock; connector for remote safety interlock; metered return and by-pass return terminals allowing measurement of either load or guard currents.

Optional features include: multiple voltage ranges; adjustable circuit breaker; vacuum tube microammeter with ranges as low as 2 microamperes, full scale; adjustable high limit voltage or current shut off; and automatic rate of rise (see page 4).

Bench Type A-C HYPOTS® . . 35 KV, 2 KVA

These high potential test sets are suited for dielectric strength testing of insulating materials, sample lengths of wire and cable, and components . . . having relatively low distributed capacitance.

Outputs available continuously variable from 0-10 kv, up to 0-35 kv, at 1 or 2 kva rating. The steel cabinet is finished in grey baked hammertone, and sloping aluminum panel in blue hammertone. Dimensions are: 20" wide, 16¼" deep at base, and 14¾" high plus output bushing. Weights from 70 to 100 pounds. (Similar to Fig. 6).

Standard features include: 4½" kilovoltmeter directly across the high voltage output; cabinet and panel at ground potential; fast-acting circuit breaker in output and thermal overload breaker in primary; zero return interlock; connector for safety interlock.

Optional features include: multiple kilovoltmeter ranges; output current meter with single or multiple ranges; dual range or adjustable secondary overload circuit breaker; adjustable leakage indicator light; automatic rate of rise control (as described on page 4).

Portable D-C HYPOT® . . 5 KV, 2 MA

Output of the Model 5205 Portable D-C HYPOT® is continuously variable from 0 to 5000 v d-c, metered in the output circuit. Measures leakage current as low as 0.05 microamperes over four scale ranges: 0-2, 20, 200 and 2000 microamperes. Operates from 115 v a-c, with selenium rectifier providing up to 15 ma for rapid charging of capacitance loads. The welded steel case has a removable lid and carrying handle. Measures: 13½" wide, 13" high, and 7" deep. Weighs 24 pounds. Descriptive bulletin available.

"HYWATT" A-C HYPOT® Jrs. . . to 10 KV, 2 KVA

For a-c dielectric strength testing to 10,000 v at 2 kva, this HYPOT® series offers economy and the convenience of a compact bench-type cabinet. (Fig. 5). Models are available with output continuously variable from 0 to 1500 v up to 10,000 v a-c, at continuous duty ratings of 0.5 to 2 kva (approximately double for intermittent duty).

Features include: 4½" kilovoltmeter connected across the output, overload protection in output and primary circuits, high voltage "ON" switch allows momentary or sustained application of test potential. Descriptive bulletin available.

A-C HYPOT® Jrs. . . to 10 KV, 230 VA

Portable a-c dielectric strength testers providing outputs continuously variable from 0-1500 v up to 10,000 v a-c. Use of neon breakdown and leakage current indicators in conjunction with collapsing field-type high voltage transformers results in an instrument that is rapid and safe for production testing.

The leakage current indicator is adjustable from 0.3 to 3 ma. A 4½" kilovoltmeter directly across the high voltage output provides high accuracy. Short-circuit current cannot exceed 18 ma. The cabinet and panel are at ground potential. (Fig. 4).

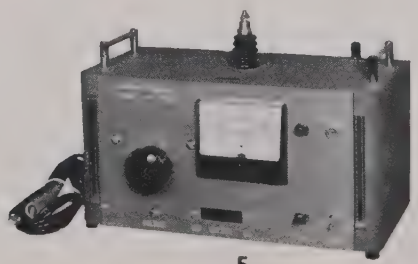
Optional features include: Leakage indicator light adjustable to as low as 0.1 ma or as high as 5 ma; retractable tip or stationary test prods. Detailed specifications for each model are available.

D-C HYPOT® Jrs. . . . compact, portable insulation leakage current testers have high voltage selenium rectifier, providing output variable from 0-1500 v, and up to 5000 v d-c at 2 ma. Short-circuit current limited to 15 ma. Case and panel similar to illustration for A-C HYPOT® Jr. Descriptive bulletin available.

HYPOT® Jr. Automatic "Squawker" Models

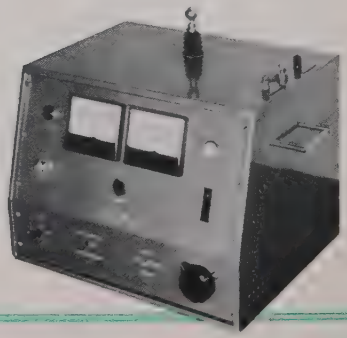
Available with output voltages from 0-1500 volts to 0-6000 volts a-c. These units are similar to the standard HYPOT® Jr. models except that an audible signal unit and external control terminals are included, which operate simultaneously with the visual indicator.

4



5

6



HYPOTS® for Special Applications

Insulating Materials Testers

Listed below are representative ARI testers for solid and liquid insulating materials. Due to the rapid progress of insulating materials and testing techniques, new equipment is added whenever required to meet ASTM, MIL and Federal test specifications.

Model 4712 Oil and Materials Tester

Provides 0 to 60 kv at 2 kva a-c, to test insulating oils and materials. Complete with safety interlocked test cage, oil cup and U.S., English and German standard electrodes. The rapid-acting magnetic breaker in the output has two sensitivity settings, facilitating tests at lower voltages. Housed in steel console cabinet with panel and cabinet grounded for operator safety.

Model 4510 Insulating Materials Tester

Test potential continuously variable from 0-50 kv a-c, at 2 kva. Numerous automatic control features facilitate testing insulating materials.

Test cage of transparent plexiglas accepts all ARI materials test fixtures and is safety interlocked to allow full view of the sample under test. Caster-mounted console cabinet. (Fig. 10).

Motor-driven rate of rise is adjustable from 300 to 3000 volts per second. Also dwell time on test sample is timer controlled and adjustable. The output kilovoltmeter has an electronic memory circuit retaining the indication on the voltage at which breakdown occurred. Descriptive bulletin available.

Model 4501 Materials Testing HYPOT®

Meets the dielectric strength testing requirements of Specification D-149, ASTM Standards on Electrical Insulation Materials. (Fig. 9). Output continuously variable from 0-35 kv a-c at 2 kva (intermittent rating). Magnetic breaker trips when specimen breaks down. Output termination in jacks at center of the lucite cabinet top accepts the interchangeable ARI materials testing fixtures. Optional features: interlocked clear lucite test cage and selection of ARI plug-in materials testing fixtures, automatic rate of rise, dual sensitivity circuit breaker, etc.

Model 4505 Insulating Oils Tester

Provides dielectric strength testing of insulating liquids in accordance with ASTM and Federal Specifications. REA approved. Output is continuously adjustable from 0-35 kv at 2 kva, a-c. Other voltage and power ratings are available. (Fig. 8).

Has 4½" rectifier type kilovoltmeter, magnetic breaker in output, zero return interlock, removable oil cup with standard ASTM 1" adjustable flat electrodes, bench type cabinet and carrying handle. Measures: 16" wide, 8½" deep and 8" high. Weight: 42 pounds. Motor driven rate of rise, dual sensitivity breaker and lucite test cage may be supplied. Descriptive bulletin available.

Model 8540 Arc Resistance Tester

Tests arc resistance of solid insulating materials in accord with ASTM Specification D495-58T. Arc intensity and duration are adjustable. Internal blower for exhaust fumes. Jig for sharpening test electrodes is included. Descriptive bulletin available. (Fig. 7).

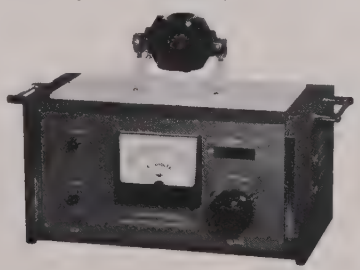
Corona Test Equipment

Detects and displays the presence of corona on built-in oscilloscope—caused by internal voids, insufficient clearances or other defects in material or equipment.

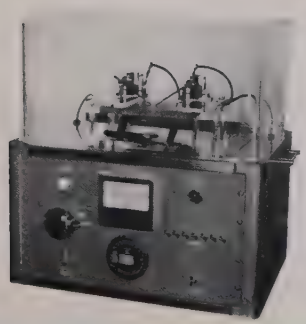
Equipment includes: specially constructed corona-free HYPOT® test set; a pick-up device to extract the true corona voltage; and the corona detection display unit. These sections are available as individual units or as an integrated package built into the ARI standard deluxe control cabinet. Outputs of 20, 30 and 35 kv are standard, although up to 100 kv may be supplied.

HYPOT® Power Supplies

HYPOT® designs provide a wide range of power supplies for special applications. D-C outputs to 250 kv and a-c outputs to 150 kv are available with current ratings from microamperes to amperes. Regulation and ripple characteristics can be supplied to suit your needs. A wide choice of housings is available.



7



8

9

10

VIBROTEST® Megohmmeters

Measure Insulation Resistance to FIVE MILLION Megohms

11

The Modern Megohmmeter

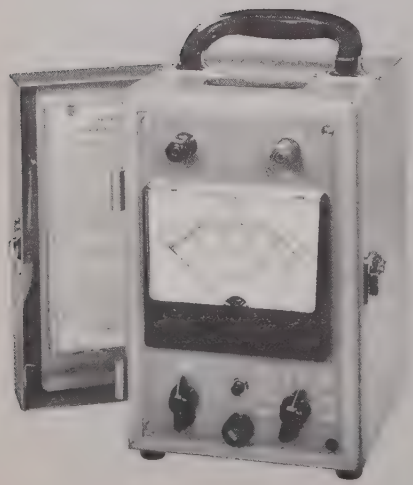
Model 2570 VIBROTEST® Megohmmeter is a portable, a-c line-operated instrument providing direct-reading measurement of resistance to 5,000,000 megohms at 500 v d-c test potential.

There are six scale ranges: 1 to 50, 10 to 500, 100 to 5,000, 1,000 to 50,000, 10,000 to 500,000 and 100,000 to 5,000,000 megohms.

The 4½" rectangular meter is calibrated from 1 to 50 megohms. The power supply uses long-life selenium rectifiers, eliminating batteries or cranking. Use of five gas diode regulator tubes assures constant test voltage despite line voltage variations from 105 to 130 v.

The instrument has a welded steel case finished in grey hammertone and a removable lid with carrying-handle. Size is 8⅞" by 6" by 8½". Weight, 11 pounds. (Fig. 11). Descriptive bulletin is available.

Model 250 VIBROTEST® Megohmmeter is similar to the Model 2570, except that four megohm measuring ranges are provided: 1 to 50, 10 to 500, 100 to 5,000 and 1,000 to 50,000 megohms.



12

VIBROTEST® Megohmmeters

for Maintenance and Production Testing

A wide selection of direct reading, push-button operated megohmmeters is available in the various VIBROTEST® models that are designed for maintenance and production testing of insulation resistance. Many incorporate low ohms ranges for measuring continuity as well as ranges for measuring a-c and d-c voltages.

Operation is from self-contained batteries which, through a unique synchronous vibrator circuit, produce test potentials of 125 to 1000 v d-c for dependable measurement of insulation resistance. All models are housed in welded steel portable cases with carrying handle and removable lid. Case and lid are finished in grey hammertone, with the panel in blue hammertone. (Fig. 12).

Special models are available for the specific requirements of electric utility service, railway control and signal (to A.A.R. Specifications) and for marine use. Complete descriptive bulletins are offered.

HOSPITAL OPERATING ROOM SAFETY . . . The VIBROTEST® Model 269 has been designed to meet N.F.P.A. Specifications for measuring conductivity of hospital operating room flooring, conductive footwear, castors and other devices to assure safety from explosions resulting from electrostatic discharges. Descriptive bulletin available.

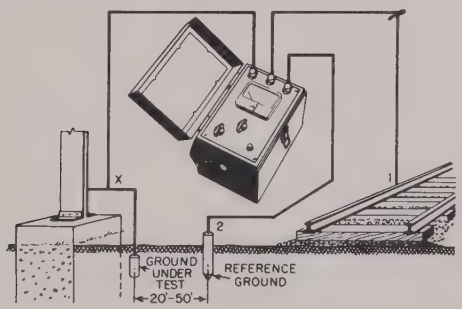
VIBROGROUND . . Measure Ground Resistivity

Resistance of Man-Made Grounds

VIBROGROUND® is the fast, accurate way to test man-made grounds for electrical and electronic systems. Ground resistance measurements made with VIBROGROUND® are direct reading and require no computations.

These instruments provide readings of actual resistance to earth of the ground connection, unaffected by stray a-c or d-c voltages and currents, as well as by length of test leads, resistance of prods and general soil conditions. All models are push-button operated with self-contained batteries and synchronous vibrator power supply. No cranking or leveling.

VIBROGROUND® Models 251, 255 and 259 provide ranges covering every requirement by utilities, telephone companies, lightning protection engineers and similar applications for measuring man-made grounds. Descriptive bulletin available.



For Corrosion Control Engineers

. . push-button measurement of soil resistivity, anode resistance, circuit resistance, polarization effects

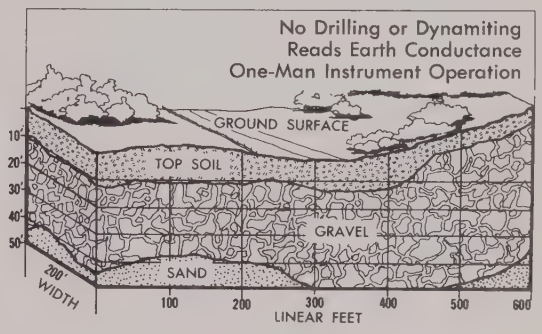
VIBROGROUND® Models 263A and 293 provide lightweight, accurate instruments for dependable measurement of soil resistivity and ground resistance . . . that operate from self-contained batteries and synchronous vibrator power supply. Complete accessories are available for two, three and four electrode methods of measurement.

Selector switch choice of ranges: 0-1, 0-10, 0-100 and 0-1000 ohms on the Model 263A and 0-1, 0-10, 0-100, 0-1000 and 0-10,000 ohms on the Model 293. Housed in welded steel case with removable cover and carrying handle. Weight 10 pounds with cover removed. (Fig. 13). Descriptive bulletin available.

Geophysical Subsoil Exploration

Electrical geophysical subsurface exploration through the use of the several VIBROGROUND® models designed for such applications . . . has received wide acceptance in many fields ranging from prospecting for mineral ores to determining subsoil profiles in connection with highway, bridge, pipe line and building construction. One of the most important applications is the wide use in highway construction and location of gravel deposits.

The VIBROGROUND® instruments for geophysical exploration provide direct readings of soil resistivity (in the case of the Model 274M, soil conductance) and are available with suitable accessory equipment for all methods of testing. These instruments are self-contained, light in weight and operate from a self-contained battery through the unique synchronous vibrator power supply. Descriptive bulletin available.

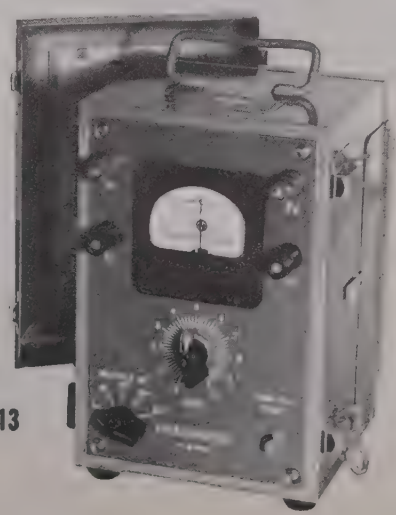


The "MICHIMHO" VIBROGROUND®

The above illustration is a subsoil profile prepared from soil conductance readings taken with the Model 274M "MICHIMHO" VIBROGROUND® . . . developed to utilize the Barnes Layer Method of subsoil determination.

This world-recognized procedure for determining the profile of subsoil layers provides data for solution of problems connected with location of highway grades, bedrock determinations, drainage slopes, and location of sand and gravel pits. The low cost of these determinations and the speed with which they can be made affords an important advance over seismographic methods and test drilling. (Fig. 14). Complete descriptive bulletin available.

14



13

Instruments for Special Applications

Automated Production Test Resistance Bridges

Model 8516 "Pilotal" Ohmmeter automatically measures resistance to close tolerances and rejects when high or low limits are exceeded, by means of indicator lights. It also actuates circuits for automatic rejection, discriminating between samples that are on the high or low side. Figure 15 illustrates the Model 8516 as set to reject with 1% accuracy at a low limit of 3.75 ohms and a high limit of 4.00 ohms. The instrument may be supplied to accept or reject at resistance values from a fraction of an ohm to 5 megohms. Test voltage is low to assure operator safety. Complete application data is available on request.

Model 8513 Pilotal Resistance Bridge may be preset for any resistance value from 1 ohm to 10 megohms (accuracy better than .1%). Models may be provided with separately adjustable high and low limits from .2% to 20%.

Automated Production Test Capacitance Bridge

Model 8529 Pilotal Capacitance Bridge shown in Fig. 16, permits automatic production testing of all types of capacitors. Center value adjustable from .001 to 1 microfarad with preset acceptance limits of ± 1% to operate go and no-go lights. Models may be furnished incorporating separately adjustable high and low limits from .5 to 20%.

Phase Sequence Indicator

A miniaturized pocket portable instrument that provides positive phase sequence indications when connected to three-phase power sources. The instant readings not only assure proper rotation of motors but guard against costly damages. This instrument weighs only 11 ounces and measures 2⅞" wide, 1⅝" deep and 4" high.

Model 40 is designed for use on 60-c circuits, and Model 44 is for use on 400-c circuits. (Fig. 17).

Portable Precision Ohmmeter

accurate to ½ of 1%

The accuracy of ½ of 1% provided by these ARI Precision Ohmmeters is up to four times improved over that of usual portable instruments . . . yet they are direct reading and retain their accuracy under severe usage.

Compensation is provided for changes in resistance of leads and battery. The welded steel case and removable cover are finished in baked grey hammertone. (Fig. 18).

Model 244 provides ranges: 0-50/500/5,000/50,000 ohms, permitting readings as low as 0.05 ohm.

Model 246 provides ranges: 0-100/1,000/10,000/100,000 ohms with readings as low as 0.1 ohm.

Sphere Gap Assemblies

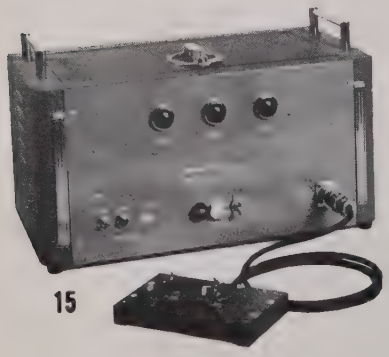
This is one of the few recognized standards for measuring high voltage. Since the calibration accuracy of a sphere gap depends upon physical configuration rather than upon electrical characteristics of the components, calibration accuracy may be positively determined by use of this device.

The ARI Sphere Gap Assembly consists of the sphere gap with micrometer gap adjustment (direct reading in inches or centimeters) and a current limiting resistor assembly. Models are available to measure potentials from 30 to 150 kv. (Fig. 19).

Portable Kilovoltmeters

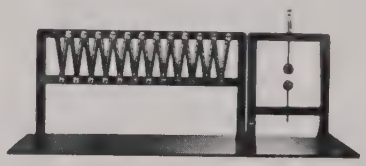
These portable kilovoltmeters measure true peak (positive, negative or both) rms, or d-c . . . or any combination of these in single or multi ranges.

Ranges from 10 to 150 kv peak or d-c, and from 10 to 110 kv rms are available. Accuracy is better than 3% of full scale. Current drawn from a circuit under test is less than 0.5 ma. (Fig. 20). The ARI Engineering Staff will supply additional data on your application.

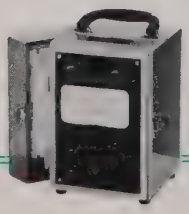


15

17



19



18

20

16

Automated Operation of Tests for Components, Cables, Materials

The ARI Engineering Staff is prepared to design and build special purpose complex automatic sequence and sensing test systems that embody high potential breakdown, insulation leakage current measurements, continuity and associated tests.

Figure 22 shows a special HYPOT® arranged to sequentially test fifty items or circuits in a single assembly at d-c potentials up to 4000 v. The position under test is indicated on a counter. When leakage current exceeds a preset level, the tests stop simultaneously with the illumination of a warning light and sounding of an alarm.

The Model 8515 Automatic Capacitor Tester Fixture may be used in conjunction with the Model 8514 Automatic HYPOT®. This is a fully automated system for life testing 50 capacitors, with memory provision, cut-out of failures, fully motorized control of voltage rise, preset dwell time for high voltage test and many other unique facilities.

The Model 8524 High Voltage Automatic Analyzer, Fig. 21, and also illustrated on page 3, provides facilities for completely automated continuity, insulation resistance and dielectric strength testing of up to one hundred and twenty cable conductors, assembly circuits or components.

A bulletin is available detailing many more unusual systems for automated testing that have been designed and produced by Associated Research, Inc.

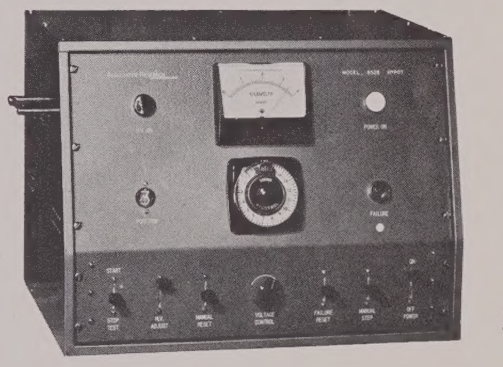
21

Current Transformers for Metering and Allied Applications

"Donut" type current transformers for metering and allied applications are available in turns ratios of 10/5 to 5,000/5 at burdens of 2.5 to 30 va and higher. Frequency response is from 25 to 400 cycles; insulated for 4000 v a-c; ratio accuracies of 1% are standard.

Inside diameter varies from 1⅝" to 3½", depending upon the model. However, any size or shape may be supplied to fit the customer's requirements.

The "Donut" current transformers are of the inserted primary type for positioning over the conductor or bus bar. Two secondary output leads are provided for direct connection to the meter or other external circuit. (Fig. 23).



22

23

The Keeler Polygraph (Lie Detector)

For twenty years Associated Research, Inc. has led in the development and manufacture of the polygraph, as an instrument essential to public safety and progressive law enforcement.

Today, ARI's Keeler Polygraph has become an important adjunct to industrial security and employee relations programs. If you would like more information on this subject, please write. (Fig. 24).

24

ASSOCIATED RESEARCH, INC.
3758 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

These ARI Application Bulletins Offer Important Data on Use of Modern Instruments

D-C HYPOT® Insulation Testing.

• •

Predict Motor Failure with Periodic Insulation Resistance Tests.

• •

High Potential Dielectric Strength Testing with HYPOT® Jrs. and Automatic "Squawker" HYPOTS®.

• •

Practical High Potential Testing.

• •

Insulation Resistance Measurement with the VIBROTEST®.

• •

Manual on Testing Insulating Materials.

• •

Your inquiry will be appreciated for application data on any aspect of high voltage breakdown testing, insulation resistance or dielectric strength measurement.

ASSOCIATED RESEARCH, INC.

3758 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

COrnelia 7-4040

Export Department

549 W. Washington Blvd. . . Chicago 6, Illinois

ANdover 3-6420

Represented by:

161-15

Printed in U.S.A.

MP MASTER
MA30111